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ADVANTAGES OF A GEOCHEMICAL APPROACH

By F. H. DAY, M.SC., PH.D., F.R.I.C.
Head of the Science Department and Vice-Principal, Carlisle Technical College

A survey of current chemistry textbooks and other literature likely to be used by students of general chemistry suggests that the idea of relating chemical studies more nearly to Nature has developed but little since Goldschmidt's lecture to the Chemical Society in 1937. With one or two noteworthy exceptions, few papers on geochemical topics appear to come directly before the notice of chemists in this country. There are several valuable texts in English but they are probably little used by ordinary students of chemistry.

It seems to me that there is still a marked tendency for chemists to be students of a man-made science in which the origin and destination of the materials they use are largely ignored. In a complete chemical study it would seem that more notice should be taken of chemical substances in both time and space and of the types of chemical reactions that go on under natural conditions.

It is perhaps unfortunate that in its earlier stages the study of geochemistry was much concerned with the accumulation of data which could not be immediately related to any general principles. At the same time there emerged various theories, often of a highly speculative character, dealing with the origin of the elements and with the structure of the Earth. However, during the two decades following the pioneer work of Goldschmidt on the fundamentals of the science, considerable progress had been made, errors corrected and more attention devoted to the elucidation of underlying principles. It is thus reasonable to include within the purview of the subject the study of the interactions of the chemical elements as they occur in Nature—a wide field, extending from the problems of the origin of the elements to the origin of life.

No teacher would wish to impose deliberately even heavier burdens on chemistry students but there is a case for the incorporation of some geochemical topics into a course of general chemistry, and this at a number of levels; some of the topics are not necessarily of great complexity, and they also often serve to illustrate important chemical principles and the inter-relation and interdependence of different sciences.

The question of the origin of the different elements clearly involves a considerable study of nuclear reactions, and the related topic of the relative abundance of the different nuclides comes into the discussion. Present theories tend increasingly to locate the seat of nuclear syntheses in stellar interiors, so that investigation of the various possibilities provides matter of common interest to the physicist, the physical chemist and the cosmologist.

At a more mundane level, the study of planetary atmospheres in general, and of our own in particular, provides some useful applications of the kinetic theory of gases.

Thermodynamics is vital to geochemistry, particularly as the concepts of free energy and entropy can help to foretell the possibility or otherwise of a reaction taking place under certain conditions. Examples taken from various geochemical situations could well be used to consolidate the student's knowledge and to stimulate interest in what is for many a difficult branch of physical chemistry.

It is scarcely necessary to point out the major contribution which mineral chemistry makes to the study of crystal structure. The wider aspects of isomorphism as developed by Goldschmidt and others are now part of the study of heterogeneous equilibrium in which phase relations, ranging from simple to very complex, are involved.

In this field the data of the analyst and the petrographer are now greatly augmented by extensive work on experimental silicate melts and analogous mineral systems.

Geochemistry provides countless examples of ionic processes, many of which are of great interest to the general chemist. Virtually all natural waters are mineral solutions which are largely ionic. To understand the secondary changes involved in the weathering of the Earth's crust, itself largely an assembly of ions, the student requires a knowledge of ionic potential, hydrogen ion concentration, redox relations and ionic solvation, to mention some of the more important factors. One of the most striking aspects of these processes in Nature is the extent to which they give rise to differentiation of elements which the laboratory student has always regarded as very closely related, *e.g.* sodium and potassium. When it is observed that the properties of colloids are much involved in the weathering of rocks and the formation of soils, it will be seen that the physical chemist can find much of value in the study of natural processes to elucidate and exemplify important parts of his subject.

The relation of inorganic chemistry to geochemistry may be self-evident, but it merits much more than the commonplace formal paragraph 'Occurrence' found in so many textbooks. It is not for nothing that 'Mellor' devotes 59 pages to the occurrence of iron.

The very general use of the periodic system as a basis for teaching inorganic chemistry is admirably reinforced by applying it to the geochemical relationships of the elements. Whilst the simple clear-cut divisions of

the earlier treatment require some qualification, it still remains true that a broad classification of the elements based on their geochemical characteristics is very simply related to the periodic table, and naturally so, because the fundamental parameters involved are electronic configuration and ionic and atomic radii.

It is also desirable that a chemist should have something more than a vague notion of the way in which the various kinds of mineral concentrations are encountered in Nature, and this can be explained and demonstrated quite adequately without any excessive involvement in geological phraseology. A small collection of selected specimens is clearly of great use. They should not, however, be the show-case specimens of the mineralogist but rather common mineral assemblies which clearly illustrate the practical problems of extraction.

The different sources of chemical raw material need to be emphasized, and also the practical importance of availability as contrasted with terrestrial abundance.

None of the types of occurrence in solid, liquid or gaseous phase can be ignored—the scientific curiosity of today may be the technical process of tomorrow—as for instance the production of sulphur from natural gas, and the great possibilities of sea-water as a source of chemicals. The inorganic chemist will also be interested in the compounds of elements which occur freely in Nature, and yet are relatively inaccessible as artificial products. Here it may be noted that a very high proportion of the known natural mineral species has now been artificially produced with, in many cases, an increase in knowledge of their mode of origin.

One point which comes out is that the attempt to divide the elements into 'rare' and 'common' is somewhat artificial, and might well be dropped. There may, indeed, be room for a reassessment of the elements most appropriate for study at elementary and intermediate levels—certainly if the subject is approached as a branch of 'natural' science and not to some extent as mere examination material. A development of this view might thus lead to some change in the complexion of teaching syllabuses. The important point is to realize the existence of a chemistry that is not confined to the restricted conditions of a laboratory or technical process where time, temperature and pressure have necessary limitations.

The organic chemist might also well consider some of the geochemical aspects of his science, both from the viewpoint of disintegration reactions of complex natural organic substances, and of the absorbing study of those interactions of relatively simple molecules, which, by providing a sub-stratum of moderately complex bodies like amino acids, may ultimately supply evidence on which can be built a convincing theory of the origin of primeval organisms and therefore of life itself. The origin of the fossil fuels and of certain mineral deposits also provides much of interest to the organic chemist and the biochemist.

If we turn now to practical work, it will be found that very much of geochemical interest could be made use of with considerable advantage, from the most elementary level to topics suitable for research. All students will at least determine the hardness of water, which is an approach to practical geochemistry, and it is clear that various volumetric exercises can be developed from this. The student's interest will be greatly increased if genuine samples of natural waters are collected and used for the purpose—it is rather deplorable that 'artificial hard waters' should often be provided. Stemming from the study of natural waters comes the important problem of detection and determination of small and trace quantities of various ions, requiring a considerably increased scope in analytical techniques.

The old-established discipline of inorganic qualitative analysis—still the backbone of examination syllabuses—can be made far more attractive by the occasional use of natural minerals as a variation on the mixtures commonly employed. In this way, too, it ceases to have an air of unreality and to be merely a series of chemical puzzles as artificial as crosswords.

Suitable minerals and ore concentrates are available, as well as selected rock material, if more difficult problems are needed. This kind of analysis will soon bring out the importance of dealing with all possible elements—not merely the orthodox members of the traditional analytical tables. For example, the ability to detect titanium (a common element in rocks) is at least as valuable as the recognition of cadmium or mercury. The extension of qualitative to quantitative methods is a natural development, and here the selection of processes appropriate to the particular material is of prime importance, and calls for judgment as well as experimental competence. Inorganic preparative work is another somewhat neglected field of laboratory work which gains much from this kind of treatment. Thus a number of selected preparations of pure chemicals can be made from natural mineral sources, *e.g.* manganese salts from pyrolusite, barium salts from barytes, bromine and magnesium salts from sea-water, and, at a more advanced level, the preparation of compounds of elements like titanium, zirconium, lithium and uranium from their common mineral sources. Some of these processes can be arranged so that they involve both micro and semi-micro techniques in the course of the same preparation.

These suggestions are capable of considerable modification or expansion. The idea behind them is primarily to introduce and keep alive the notion that chemistry is indeed part of the study of the natural world. Incidentally, it stimulates the student by drawing attention to topics that are valuable in themselves to the proper understanding of chemical principles, and it makes some attempt at inter-relating chemistry and other sciences to a greater extent than has been customary in the past.

THE LAW OF COPYRIGHT

By S. I. Levy, M.A., PH.D., F.R.I.C.

The Copyright Act of 1956, which came into force on 1 June, 1957, made several changes in the general law of copyright, which had remained almost unchanged since 1911. The nature of copyright in literary works, though extended and defined more fully, is not substantially altered by the new Act. Copyright gives to its owner, subject to certain provisos, the exclusive right to produce or reproduce a work or any substantial part of it, and thus the right of action in the Courts against any person copying the whole or any considerable part of it. These rights are personal property, and can be sold or licensed in whole or in part in the same way as other personal property.

The right of an author to prevent others from reproducing his work without his consent was part of the common law of England. It became a statutory right in the reign of Queen Anne, and the effect of subsequent statutes, and finally of the Act of 1956, has been to abolish the common law right and to define the rights of the copyright owner in greater detail. They remain in essence the right to prevent unauthorized reproduction and (as regards scientific or technical literary works) the right to prohibit not only reproduction in any material form, but also broadcasting and translating.

Copyright does not extend, and never has extended, to the protection of ideas or to matters of scientific or technical fact. It is directed rather to the form in which ideas or facts are expressed, and though by no means limited to exact copying, affords no protection against the use by others of the matters of fact or the theories or concepts described or set out. Even when the facts are new and are obtained as the result of original research, or where the theories or concepts are the result of original thought, the facts or theories themselves, apart from the form in which they are expressed, receive no protection under the present law, and anyone is free to use them without infringing copyright, so long as he does so without copying the form in which they have been set out by the author.

In the Act of 1956 the definition of a literary work includes 'any written table or compilation', and writing includes 'any form of notation, whether by hand, or by printing, typewriting or any similar process.' Copyright therefore does not subsist in spoken matter as such, though it arises as soon as the spoken matter is reduced to writing. Under the Act of 1911, a literary work was defined so as to include maps, charts and plans, but the Act of 1956 omits these from the definition; thus diagrams and illustrations in a chemical book or paper are now protected as artistic and not as literary works; though artistic and literary works are dealt with to some degree in different sections of the Act, however, the degree of protection afforded, at least so far as scientific and technical books and papers are concerned, remains much the same.

OWNERSHIP OF COPYRIGHT

Copyright normally comes into existence automatically as soon as the work is made, that is, as soon as a literary work is written or as soon as diagrams, sketches, drawings or photographs are made. Publication is not a necessary requirement for copyright, unless the author is neither a British subject nor domiciled in any country or territory that adheres to the Copyright convention.

The general rule is that the author of the work is the owner of the copyright, which comes into existence on the making of the work. He is therefore the only person who has the right to deal with the work and to authorize dealing with it. This general rule, however, is subject to some exceptions, the chief of which, for the present purpose, arise when the work is made by the author in the course of employment under a contract of service and when the ownership is provided for by agreement.

Though chemists are not generally employed to write books, papers or articles, questions may arise as to whether such works were made in the course of employment. Copyright in the reports of research departments or in papers written by the employee on the results of work carried out under the direction of the employer would appear, in the absence of agreement providing for the ownership, to rest in the employer. Thus, though publication without permission of the employer would in such circumstances usually be held by the Court to come under the wider ground of breach of confidence, it might also constitute infringement of copyright.

Publication of a scientific or technical book usually takes place as a result of agreement between the author and the publisher. The agreement will generally deal with the ownership of the copyright, but it is important to see that it deals with all aspects. As has already been pointed out above, the owner's rights cover not only reproduction in any material form, but include the right to broadcast and to translate, translation into each foreign language constituting a separate right. Agreements for publication might thus deal separately with the rights to reproduce parts or the whole of the book in technical and scientific journals, to translate into other languages, to publish in other countries, to broadcast and so on; one or other of the parties may wish to obtain or reserve some of these separate rights; for

example the author might wish to retain the right to translate into Russian, whilst the publisher may expect to get the right to reproduce in America.

Agreements for publication of scientific and technical papers and articles vary considerably. Scientific societies frequently prescribe the terms as to ownership of copyright on which they are prepared to undertake publication; where no rules are laid down or no agreement is made, the copyright, other than the right given to the particular society to publish in its own journal, which must be implied from the offer of the paper, will remain with the author. If the society desires to secure legal ownership of the whole or any part of the copyright, it must take care to obtain the signature of the author to an appropriate agreement, since assignment of copyright must be in writing; this may be of importance in some cases, since the legal owner of the copyright must be a party to an action for infringement. Where payment is made for the work, as may be the case for papers or articles published in technical journals or scientific magazines, the publisher will usually expect to obtain the whole copyright; here again, however, the terms are a matter for agreement, and if the author desires to retain any particular part or parts of the copyright, he should see that the agreement makes the necessary provision.

REDRESS FOR INFRINGEMENT

The grounds on which the owner of copyright in a literary work may obtain redress from the Court are set out in Section 2 (3) of the Act of 1956. Those of chief importance to authors of scientific or technical literary works are the reproduction of the work in any material form, its publication, and the broadcasting of it; a later part of the Act, Section 49 (1), makes it clear that protection extends to any substantial portion of the work.

Reproduction 'in any material form' covers any printed or written copy, a shorthand or even a Braille report, or a record made by any type of recording machine. Altogether distinct from the copyright in the original work, a kind of secondary copyright arises in the reproduction in each of the possible material forms, *e.g.* in a shorthand report or a tape recording of a reading of the work. Such secondary copyright, if the reproduction has been made with the licence of the owner of the main copyright, or falls within the provisions dealt with below allowing reproduction in certain circumstances, belongs to the person making the reproduction; if made without licence, or if not within the permitted limits, it is an infringement; if then the owner of the main copyright brings an action and is successful, he is deemed to be the owner of the secondary copyright also, and all infringing copies and any means of making them are deemed to be his property, and must be handed over to him.

The second type of infringement, publishing the work, means that reproductions of the work have been issued to the public; this type of infringement would thus appear to arise if a lecture or a substantial part of a lecture were printed and published without the licence of the author, even if the lecture had not before been reduced to writing.

The third type of infringement, broadcasting the work, includes both sound and television broadcasting, and does not necessarily require that any infringing copy be made. Secondary copyright arises in material broadcast by the B.B.C. or the I.T.A. and resides in those bodies, subject to the main copyright in the author.

Sometimes it is difficult to determine what constitutes 'a substantial part' of a literary work for the purpose of deciding whether or not infringement has occurred. In cases that have been reported, emphasis has been placed on the 'value' of the work to the author. The Court has generally held a later work to be an infringement if it is satisfied that its author has made substantial use of the skill and labour of the earlier author, even when the part of the earlier work actually reproduced in the later has not been very large. The Court would probably still apply that principle in dealing with textbooks, or even with monographs and works of reference. In dealing with papers describing original research and similar contributions to journals published by scientific bodies, the value to the original author is not perhaps the main matter to be considered; if the question is whether a substantial part of an earlier paper has been taken, it would probably be decided after full consideration of the exceptions from the ambit of literary copyright that are permitted by the law in the public interest.

EXCEPTIONS FROM COPYRIGHT PROTECTION

English law has long recognized that limited use of copyright material may be desirable in the public interest. The extent to which such use may be made of literary work without becoming liable for infringement of the copyright, is set out in Sections 6 and 7 of the Act of 1956. Here we need consider only such uses in connection with scientific and technical papers and books as are likely to be of interest to chemists.

Section 6 (1) provides that fair dealing for purposes of research or private study does not constitute infringement, and it is not necessary to make acknowledgement of the work dealt with. If the results of such research or study are not published, the question of acknowledgement does not arise. If the results are published, acknowledgement will be necessary only if any substantial part of the work dealt with is reproduced. I am dealing here only with the requirements imposed by law. It is, nevertheless, the custom of scientist-authors to acknowledge all earlier publications to which they refer directly, both out of courtesy and to identify the matter to which reference is made; it is clearly in the best interests of science that the fullest acknowledgement should continue to be made whenever reference is made to earlier published work.

Section 6 (2) provides that if any substantial part of a literary work is taken for purposes of criticism or review, is fairly dealt with and is sufficiently acknowledged, there is no infringement. In Section 6 (10) 'sufficient acknowledgement' is defined as identifying the work by its title or other description and also identifying the author. There is no definition of fair dealing in the Act; use of published material solely for advancing or spreading scientific knowledge would generally be held to be fair dealing, whereas copying considerable extracts of an earlier textbook by a different author into a later textbook would generally not be regarded as fair dealing.

Section 6 (3) affords the same protection when the work is used for the purpose of reporting current events; again the use must be fair, and if it is in a periodical, there must be sufficient acknowledgement, though if made by means of broadcasting, or in a film, no acknowledgement is required. Reproduction in judicial proceedings or in a report of such proceedings is protected by sub-section 4, and the reading of a reasonable extract in public by one person is protected by Section 5, subject to acknowledgement and provided that nothing is broadcast.

PROTECTION FOR LIBRARIES

Section 7 of the Act makes exceptions in favour of certain libraries in a class prescribed by the Board of Trade; in effect this includes all libraries likely to receive scientific and technical publications of any kind. Provided such libraries are not conducted for profit, they may make single copies of articles in periodicals and supply them to persons requiring them for purposes of research or private study only, without infringement of copyright. The librarian must be satisfied that the copies will not be used for any other purpose, and must require and receive payment of a sum not less than the cost of making the copy. Similar provisions apply in respect of copies of parts of books or matter published other than in a periodical; however, if the librarian knows or could by reasonable inquiry find out the name and address of the owner of the copyright, the protection is lost. The protection is not limited in any way as to the method of copying employed, and it covers written, typed, photographic and other copies; only one copy may be supplied to any one person, and a copy must not include more than one article.

Sections 6 and 7 extend considerably the protection afforded to fair dealing provided by the Copyright Act of 1911, which contained no provision giving express protection to libraries. Under the earlier act, difficulties sometimes arose when scientists sought to obtain from libraries copies of papers published in the various journals, but these were very largely met by the Fair Copying Declaration prepared by the Royal Society. The subscribers to that declaration, who were mainly British scientific societies and institutions, and some other publishers, gave to libraries and other information-providing organizations—in respect of copying from periodicals only—much of the protection which has since been embodied in Section 7 of the Act of 1956. It was thus the initiative taken by the Royal Society which led to the provisions for the more extended protection afforded by the present law to libraries, not only for making copies of papers and articles in periodicals, but also for making copies of parts of books. The purpose for which the declaration was prepared has thus been met, but the present list of subscribers still fulfils a useful purpose as indicating those periodicals from which copies of articles will be supplied by libraries without the necessity of referring to Section 7.

It is to be noted that the protection afforded by the Fair Copying Declaration was complete only if the publisher was the owner of the whole copyright in the matter contained in his periodical. No doubt this was generally so. However, if the author had assigned to the publisher only the right of publication in that particular journal, the declaration did not bind the author, and, unlikely as the contingency would have been in practice, there was nothing in law to prevent the author in those circumstances from applying to the Court to restrain infringement by the library or anyone else. Sections 6 and 7 of the present Act, however, afford complete protection to libraries or persons acting under their provisions, without regard to the question of who may be the owner of the copyright.

Polypropylene in the U.K.—The first British plant for the bulk manufacture of propylene came on stream at the Wilton Works of Imperial Chemical Industries Ltd last month. The unit is capable of producing 11,000 tons of Propathene a year. (A second plant, being built by Shell, is expected to be in production early in 1961.) Work began on the Wilton site in May, 1959, when the agreement with Montecatini was announced, and the main plant was completed in September this year.

Silvertown Works Closes.—The Silvertown soda factory of Imperial Chemical Industries Ltd, Alkali Division, will be shut down next March, the manufacture thereafter being centred upon the Winnington plant.

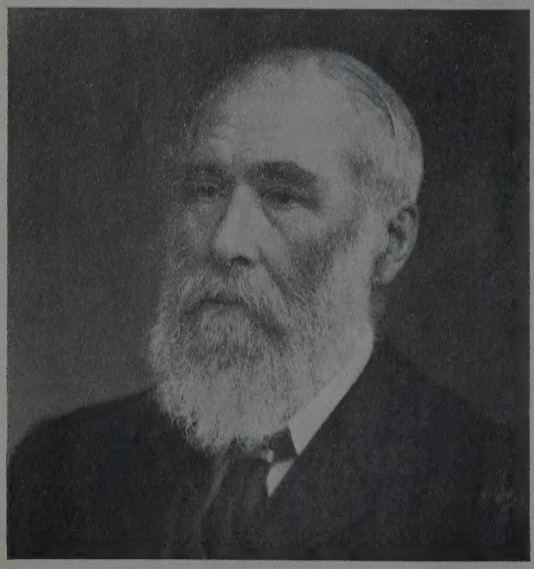
Silvertown Works of Brunner, Mond & Co. was built in 1894 to make washing soda from soda ash brought from mid-Cheshire. A year later a caustic soda plant was erected, but just before the first world war caustic soda manufacture was concentrated at Winnington. During the first world war the disused caustic plant at Silvertown was adapted as an emergency measure for purifying TNT. The plant at Silvertown was destroyed in a fire followed by a disastrous explosion in January, 1917. The works was rebuilt and continued, later under I.C.I., to manufacture washing soda.

FORMER PRESIDENTS OF THE INSTITUTE

THOMAS STEVENSON, 1838-1908
Seventh President, 1897-1900

By K. R. WEBB, B.SC., PH.D., F.R.I.C.

There could have been few attentive readers of the national press during a period of about a quarter of a century (1882–1908) who were unacquainted with the name of our seventh President, Dr (afterwards Sir) Thomas Stevenson. This was because of his important role as an expert witness for the Crown in a number of sensational poisoning cases during his service as Senior Scientific Analyst to the Home Office. We shall also see later that his period as President of the (Royal) Institute of Chemistry marked an important development in the part ever since played by the Institute in the training and certificating of public analysts, on whose work local authorities and the general public can rely for precision and fairness, and for protection against many forms of adulteration of foods and drugs.



Sir Thomas Stevenson, M.D., F.R.C.P.
Senior Scientific Analyst, Home Office

Thomas Stevenson was the second son and fourth of the six children of Peter Stevenson, well known during the middle third of last century as a pioneer of scientific farming. He was born at Rainton in the parish of Topcliffe, between Ripon and Thirsk, in the North Riding of Yorkshire on 14 April, 1838. It is perhaps worth mentioning that the Stevenson family had long been associated with this district, the very first entry in the Topcliffe parish registers being of a Stevenson marriage.

Thomas received his early education at Topcliffe in what, for the time, was a most progressive school; it boasted a laboratory in which he learned enough chemistry to enable him to make rough analyses of agricultural materials, such as soils and fertilisers, for his father (*see* the obituary notice of Stevenson by C.E.G. in *J.C.S.*, 1909, **95**, 2213). In 1853, when about 15, young Stevenson was moved to London, where he continued his scientific studies at Nesbitt's Chemical School in Kennington Lane. It should be noted that several well-known chemists of last century, including Professor W. Odling, and also A. H. Allen of Sheffield were, at different times, pupils at Nesbitt's in addition to Stevenson, who stayed there about two years. During 1855–56, Thomas was at home again on the farm with his father, presumably learning at first hand about scientific agriculture, and applying the chemical knowledge he had gained; however, by 1857 he seems to have decided on a medical career and for some time was a pupil with a Mr John Steel in Bradford. Two years later (1859) Stevenson was back in London, where he began his brilliant career as a student at Guy's Hospital Medical School. His outstanding work there brought him several prizes including, in 1862, the much-coveted Treasurer's Gold Medal in Medicine. In the same year, he became M.R.C.S. and L.R.C.P. (F.R.C.P. in 1871), and in 1863 started to practise in Bradford. However, in a few months he returned yet a third time to London, graduated M.B., taking the Scholarship in Forensic Medicine, which branch was afterwards to be his special line, and in 1864 graduated M.D. (London), still aged only 26.

For the next six years (1864–70) Stevenson was demonstrator in practical chemistry at Guy's Hospital Medical School. He then became lecturer in chemistry there, conjointly with Dr H. Debus, of polythionic acids fame, and in succession to Dr W. Odling. He retained this position for 28 years, and was also, for about 30 years (1878–1908), lecturer on forensic medicine and medical jurisprudence at Guy's, in succession to Dr Alfred Swaine Taylor. In addition to these essentially teaching posts, Stevenson was for about 10 years (1868–78) Medical Officer of Health for St Pancras, Middlesex, and in 1873 was appointed Public Analyst for the Borough of St Pancras, and also for the Counties of Bedford and Surrey.

His long association with the Home Office began in 1872 when he was appointed to the position of analyst. About nine years later (1881) he became Senior Scientific Analyst, which office he held until his death 27 years later. In those days the properties and actions of various highly toxic materials, especially those of the vegetable alkaloids, were as yet very inadequately known, and in many cases, too, accurate information was lacking about their analytical reactions, so that there were few unequivocal specific tests and reactions known by which individual members of this important class of poisons could be distinctly identified. All this was made especially clear in at least one of the celebrated trials to which allusion was made at the beginning of this account, and in which Stevenson was an expert witness for the Crown. This was the Lamson case, which was before the Courts in 1882, and in which the then very imperfectly known aconitine was the poison used. Incidentally, a reconstruction of this famous case was broadcast on B.B.C. sound radio last autumn. It is enough to say here that Stevenson finally identified the toxic substance by tasting an extract prepared from the murdered boy's stomach! He described, in evidence, the very peculiar sensation produced on the tongue, which he had found to be characteristic for aconitine, and stated that, at various times, he had tasted most of the alkaloids! It certainly needed personal courage and stamina of no mean order to be a practising toxicologist in those days. He was also involved in the cases of Mrs Maybrick (arsenic) in 1889; Dr Thomas Neill, or Cream (strychnine) in 1892; George Chapman (antimony) in 1903; Miss Hickman (morphine) also in 1903, and Arthur Devereux (morphine again) in 1905. Dr H. D. Rolleston, who wrote the article on Stevenson's life in the *Dictionary of National Biography*, said of him: 'He was an admirable witness, his evidence being so accurately and carefully prepared that cross-examination strengthened rather than weakened its effect.' Again, Lord Brampton (formerly Mr Justice Hawkins) paid him this tribute: 'He is a man who in giving evidence before me has always convinced me that he was right, and that it was useless to oppose him. I have admired him for his intelligence and knowledge, and respect him for his courage, candidness and truth.'

Stevenson's contributions to the literature of chemistry consisted mainly of papers on toxicology and analytical methods. They were published in *The Analyst* or in the *Guy's Hospital Reports*; to the latter, for instance, he made 18 contributions in all. He edited and considerably enlarged the third edition of Dr A. Swaine Taylor's *Principles and Practice of Medical Jurisprudence* (1883), and, in collaboration with Sir Shirley Murphy, he edited a work called *Hygiene and Public Health* (1894).

Stevenson became a Fellow of the Chemical Society in 1864, served four times on the Council and was for some years a Vice-President. He was among the founders of the Society of Public Analysts, was the first Treasurer of that body, and became its President in 1896. He was also for a period President of the Society of Medical Officers of Health.

In the case of the (Royal) Institute of Chemistry, Stevenson was one of the original Fellows (1877), was a member of the first, and of three subsequent Councils, and had been a Censor in 1889–90 and 1893–94 before his election as seventh President in 1897. His first desire on becoming President was to see 'the Institute authoritatively recognized as the qualifying body for public analytical appointments, and immediately took this matter in hand so far as public analysts were concerned' (R. B. Pilcher, *History of the Institute of Chemistry, 1877–1914*, London, 1914, p. 142). Accordingly, the Council resolved to hold an examination in therapeutics, pharmacology and microscopy, this examination being incorporated with the analysis of water, food and drugs, including assay of alkaloids (so-called Branch E in the Final Examination for the Associateship). Dr Stevenson himself undertook the duty of Honorary Examiner in these new additional subjects, and the first examination was held in October 1898. The Sale of Food and Drugs Act, 1899, regularized and confirmed the position of the Institute *vis-à-vis* the appointment of public analysts, in reasonable accordance with Stevenson's aims.

In his first Presidential Address (1 March, 1898), he referred to the then recent establishment of a library at the Institute, which was considerably added to in the course of that year, through Stevenson's kind interest, when nearly 360 volumes were given by Mr Robert Gordon, brother of General Gordon. This collection had belonged to Mr Frederick Perkins of Messrs Barclay, Perkins and Company, and consisted in the main of historically interesting scientific works published between 1750 and 1860, including a complete set of the *Annales de Chimie et de Physique* from 1789 to 1854.

Another development in Institute affairs came in 1899, when bacteriology was added to the list of optional subjects, one of which had to be taken by candidates training for the Associateship Examinations; furthermore, a new branch, biological chemistry, was added to the syllabus of the Final Examination. This recognized the developing importance of such matters as water, sewage and effluent treatment, the fermentation and related industries, and the general importance of chemical and biochemical methods in Public Health work.

In his final Presidential address, on 1 March, 1900, Stevenson reviewed briefly his period of office. He dealt 'chiefly with the establishment of the examination for public analysts and for biological chemists, the increasing stringency of the regulations for the admission of members, and the improved status of the profession.' He considered, too, that 'the mutual help which members had been able to afford one another, and their association for a common object had done much good.

He remarked on the higher tone, the more cordial co-operation and goodwill generally prevalent among chemists then as compared with a quarter of a century earlier.' Thus, in 1900, it is clear that the (Royal) Institute of Chemistry was already a sound, flourishing, influential and higher respected professional body—as it has always remained.

In 1867 Stevenson married Agnes, daughter of George Maberley, a London solicitor, by whom he had two sons and five daughters. By a tragic twist of fate, his elder son was drowned at Whitby in August, 1895; Dr Stevenson himself 'had been instrumental in saving the lives of a number of people (nearly 30) by the protracted use of artificial respiration after they had been brought out of the water insensible.' His younger son became a doctor and practised in Cambridge, while one of his daughters 'greatly distinguished herself in the medical profession, being M.D. (London), B.S., and Gold Medallist in Surgery.' She afterwards became a sister in the Oxford Mission at Calcutta.

In 1904, Dr Stevenson was knighted for his services to science and forensic medicine. A friend said of him: 'Stevenson's was a most estimable character, upright and truthful. He was ever kind and courteous, and always ready to help. Both he and Lady Stevenson were imbued with deep religious feeling, which was not apparent to those who were only casually acquainted with them. They both unostentatiously did lasting philanthropic work in the neighbourhood in which they lived.' In the latter part of his life, their home was Sandhurst Lodge, Streatham.

Stevenson did not long survive his wife, who died on 17 January, 1908. Just over six months later, on 27 July, he also died, aged 70, and was buried at Norwood Cemetery.

Professor P. F. Frankland, who was then our President, spoke thus of his predecessor: 'Sir Thomas Stevenson was one of those men who leave an indelible impression on all who know them. In talking with him, one immediately recognized the presence of a successful man, with wide experience of the world, who was nevertheless quite untainted by those petty ambitions, that childish vanity, and the ludicrous egotism which unfortunately too often disfigure men who have made their mark in the professions. His high sense of duty, his urbane and genial manner, and his extreme modesty withal, rendered him as widely popular as he was highly esteemed. I have no hesitation in saying that his was an influence for good in our midst which we can ill afford to lose.'

CHEMISTRY IN WINEMAKING

By G. OSGOOD, M.A., C.I.MECH.E., F.R.I.C.*

Managing Director, John C. Carlson Ltd and British Frames Ltd

Wine is a beverage produced by the fermentation of grape juice by the traditional methods of the district in which the vines are grown.

In Germany grapes are grown mainly along the banks of the Rhine and Moselle, which rise steeply from the river, and in the adjacent plains. The best wines come from vines planted on the sections of the banks which face south to obtain the maximum sunshine. In the plain between the Rhine and the Nahe the plantations are on level ground. In the Rhine plain and on the Nahe the soil is rich and red but along the Moselle it is grey slate and very poor.

During the late nineteenth century the European vineyards were almost entirely destroyed by Phylloxera, thought to have come with some stock from the U.S.A. As the roots of the American stock were immune, the European growers grafted their own cuttings on to the American stock and it is these graftings which are the basis of the European stock today. Every year a fraction of the old stock is rooted out and is replaced by young plants. A grower usually has about one-fiftieth of his vineyard fallow. Most of the vineyards are densely planted; a newer method tried after the war, when the vines were planted in rows about 5 ft apart, instead of the conventional 3 ft, to allow more sunlight to reach the plants and possibly the planting of food crops between the rows, was not very successful.

Three principal types of grapes are grown in Germany: the Riesling, the Sylvaner and the Traminer. The Riesling is favourite for it produces a wine of delicate flavour and bouquet. The Sylvaner gives a lighter wine which matures more quickly, and the wine produced from the Traminer is light and pleasant, whereas that from the Gewurztraminer, a near relation, has a muscatel-like flavour and spicy bouquet.

The success or failure of a harvest depends on climatic conditions; a wet or cold summer can be disastrous. The hot sunny summer of 1959 produced wines which will be well above average this century; had there only been a few days' rain at the end of October, the vintage might well have been 'the year of the century.' The plants need both sunshine and sufficient rain but each at the right time. In late April or early May frost can

* Based on a lecture to the Thames Valley Section, 15 January, and to the North Lancashire Section, 31 March.

be disastrous to the young buds. Some vineyards have an overhead spray unit used if the temperature drops to freezing in May; the thin film of ice that forms on the budding plants protects the sap against freezing. There is also the danger of insect pests, blight and so on. Every village has its own communal spray unit which prepares and distributes Bordeaux mixture and other fungicides and insecticides. One fungus which attacks the mature grape is welcome, the Noble Mould, which is a greyish fungus causing chemical changes that greatly improve the wine.

Pruning is generally done in two stages; during August, the tall plants are top pruned and later the lower leaves are cut off to allow the sun to reach the bunches of grapes. When the grapes are nearing maturity the Mayor of the township, in company with the growers and local government officials, visits the vineyards which are then closed and no operation other than pruning is permitted before the grapes are harvested. The owner decides just when he will harvest.

The wines are classified according to how the grapes are harvested. The following are some of the terms that are guides to quality and are printed on the bottle when the grapes have been specially selected or gathered apart from the general harvest:

Spätlese—the grapes have been left about a month after the normal harvest, giving a superior wine.

Auslese—wine made from specially selected large juicy bunches, often richer and sweeter than ordinary harvest wine.

Beerenauslese—wine made from grapes bearing the Noble Mould which have been picked individually for size and ripeness; very little of this wine is available.

Trockenbeerenauslese—wine made from individually picked berries carrying the Noble Mould which have dried until they resemble raisins. This is very sweet, rich and almost a dessert wine. Very little reaches this country.

Apart from this general guide to quality, the type of grape appears on the label as well as the name of the township, the vineyard and grower. In general the name of a wine is that of the town or village where produced, for example:—Niederhäuser Rosenheck, Riesling Auslese is a Riesling wine made from selected bunches grown in the Rosenheck vineyard of Niederhausen.

The harvested grapes are fed into presses and mills are used to decorticate the berries. The temperature in the cellars is kept low and everything is scrupulously clean. The pressed juice is run into large tanks, left to settle for a short period and decanted. Centrifuges may be used to hasten the initial settling. The must, as it is now called, is left to ferment and then to self-clarify.

The clear fermented wine is decanted into fresh casks for fining which is done by adding and mixing Isinglass or egg albumen. A thin webby precipitate forms to which any solid matter adheres and is carried to the bottom of the tank. After further maturing and settling combined with finings, the wine is fit for sale. The best wine is bottled and labelled for marketing, the second best is casked for bulk sale and the rest is used to refresh the workers.

Chemical changes which occur in the grapes as they ripen have been followed. The ripening increases the sugar and decreases the acid content (Table I). The

TABLE I

CHEMICAL CHANGES DURING RIPENING

Date	1000 berry weight (g)	Sugar content (g)	Acid content (g)
17 July	1094	6·1	26·8
30 July	1300	9·2	34·0
13 August	1694	57·9	44·2
20 August	1700	88·6	37·0
27 August	2571	248·0	31·7
10 September ..	2477	360·8	22·1
21 September ..	2508	454·5	19·3
1 October	2008	335·5	15·2
13 November ..	1588	297·1	13·5

(After Vogt, *Weinchemie und Weinanalyse*)

TABLE II

CHEMICAL CHANGES DURING RIPENING WITH 'NOBLE MOULD'

Date	Condition	1000 berry weight (g)	Sugar content (g)	Acid content (g)
17 September	Sound	1444	266	13·7
5 October	Sound	1635	276	13·3
12 October	Slight 'Noble Mould'	1259	235	11·9
22 October	Strong 'Noble Mould'	1045	187	6·2

(After Vogt, *Weinchemie und Weinanalyse*)

Noble Mould removes acid, sugar and water but more acid is removed than sugar so that relatively the sugar is increased. The volume of must obtained is also decreased so that the quality of the wine is changed (Table II). If fermentation is allowed to proceed normally, the rate of fermentation rises to a maximum and then falls. Better quality wines appear to be produced if the fermentation rate is allowed less variation; consequently the must may be cooled during part

of the fermentation period (Fig. 1, Table III.). Another method of reducing the rate of fermentation is to use sealed tanks so that the carbon dioxide is retained and the fermentation proceeds at lower speed under a higher pressure. The Law of Mass Action is thus applied to produce a better quality wine. Ferric iron and cuprous copper are undesirable but it is difficult to

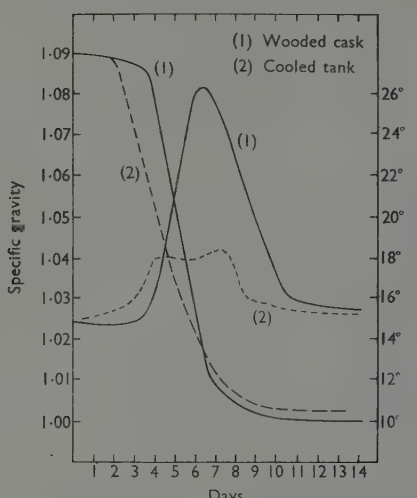


FIG. 1. After Troost, *Die Technologie des Weines*

remove one in the presence of the other by racking and aeration particularly as the flavour of a wine is closely related to its rH value. Recently potassium ferrocyanide has been introduced to precipitate these metals.

TABLE III

INFLUENCE OF TEMPERATURE ON FERMENTATION

	Cask wine	Cooled tank wine
Alcohol	89·2	91·2
Sugar	3·2	7·5
Sugar-free extract	25·7	24·5
Total acid	6·9	6·1
Volatile acid	0·5	0·6
Lactic acid	0·9	0·8

Calcium phytate can also be used to eliminate iron. Base exchange resins are gaining in popularity today, particularly for table wines. A careful chemical control is required to ensure correct dosage of the fining agents.

Book Reviews

HOMOLYTIC AROMATIC SUBSTITUTION. G. H. Williams. Pp. vii + 133. *Oxford: Pergamon Press Ltd*, 1960. 45*s*.

Considerable scientific interest in homolytic, as distinct from heterolytic, reactions was aroused in 1934 when D. H. Hey and his colleagues emphasized that the arylation of benzene derivatives by diazo-compounds, and later by aroyl peroxides, did not obey current 'Laws of Aromatic Substitution.' At this period these 'Laws' were merely qualitative, but so too were the observations which could be correlated by them. Today, however, these qualitative laws can be amplified by quantitative theories of wave mechanics and, correspondingly, applications of several physical techniques now permit organic chemists to obtain quantitative data concerning aromatic substitution processes of all types. The time is now ripe, therefore, for the quantitative reassessment of theories and facts concerning aromatic substitution, and Dr G. H. Williams, a collaborator of Professor Hey's for several years, has set out in detail the available evidence on all aspects of homolytic aromatic substitution.

In an early chapter on theoretical aspects of this subject, he points out that various theoretical treatments have been attempted, that these are only in qualitative agreement amongst themselves and that present theories, at best, have but mediocre qualitative accord with experimental evidence.

Later chapters show that homolytic aromatic substitutions, by various reagents, have been fairly conclusively proved to occur by addition mechanisms, though in some cases the question of attack by ions or by neutral radicals is still arguable. The key data concerning 'partial rate factors' for homolytic substitution are well set out and discussed, due weight being given to evidence that all homolytic substitution reactions still show some 'partial ionic character'—a finding which has not, as yet, been taken into account by theoretical computers.

Each chapter of the book is well documented, and the monograph is to be commended for the properly balanced report it gives of the observations of British, German and American groups of workers, amongst whom there are, as is to be expected in a rapidly advancing subject, many sharply differing viewpoints but general experimental accord. The book does thus succeed in giving a reliable picture of the present state of its theme without tending to any polemic bias. It may commend itself to only a restricted group of chemists, but such is the fate of most monographs of this character, however carefully they have been prepared.

Dr Williams is to be commended for his thoroughness.

W. A. WATERS

THE NATURE OF THE CHEMICAL BOND AND THE STRUCTURE OF MOLECULES AND CRYSTALS: AN INTRODUCTION TO MODERN STRUCTURAL CHEMISTRY. Third Edition. L. Pauling. Pp. xx + 644. *Ithaca, New York: Cornell University Press; London: Oxford University Press*, 1960. 60*s*.

The first edition of Pauling's *The Nature of the Chemical Bond* came out in 1939 and the second, only a little changed, in 1940. The book brought together the first comprehensive interpretations of chemical bonding and of molecular and crystal structure in terms of quantum mechanics; it was non-mathematical and written with a feeling for the facts and subtleties of chemical behaviour. Moreover, Pauling himself had already contributed massively to the subject. The volume had an immediate and profound effect on chemical thought, and has never ceased to be read and used as a source of stimulus as well as of information.

Now, 20 years later, there is a third edition with much added material, some few sections dropped and many changed. A large part of the text of the second edition remains. There are added sections on the Virial theorem and the Hellmann–Feynmann theorem (two pages). A nine-page section of the old edition on the formal rules for covalent bond formation has been expanded into a new 34-page chapter, mainly by including an account of the electronic structure of atoms; two and a half pages have been added on the correlation of colour and bond character, and six pages of new text are devoted to an analysis of the nature of the theory of resonance. The relation of bond length to bond order is now treated at greater length, with special reference to aromatic hydrocarbons. There are now 24 pages on electron-deficient substances, including boranes and substances with bridging methyl groups, and eight pages on ferrocene and related substances. The treatments of the metallic bond and of the hydrogen bond are much expanded, the latter especially by inclusion of sections on proteins and nucleic acids. Finally, there are 50 pages of added text in 12 Appendixes, on physical constants, the Bohr atom, lists of hydrogen-like orbitals, Russell–Saunders states of atoms, resonance energy calculations, valence-bond wave functions, molecular spectroscopy, the Boltzmann distribution law, electric polarizabilities, magnetic properties, strength of the hydrohalogenic acids and bond energy. As well as these considerable additions there are very many smaller changes to the text, in bringing quoted values of molecular dimensions up to date, and so on.

Pauling's choice of new material, and often his treatment of it, is controversial. Probably any narrow choice from so wide a field would be. However, his rigid adherence to resonance descriptions of bonds in molecules great and small frequently seems forced, sometimes almost calculated to highlight the weaknesses of a method which in its more appropriate fields can be so powerful. The new section on ferrocene illustrates once again that resonance descriptions are not at their best in systems of high molecular symmetry, because individual resonance structures do not exhibit the symmetry at all well and lead to clumsy models. Clumsy is surely the word for Pauling's ferrocene and nickelocene models, with no less than 560 and 4,100 structures respectively. It is no accident that for such molecules molecular-orbital descriptions have been developed almost exclusively; by showing how the symmetries of the delocalized orbitals of the carbon rings match those of the central metal, they allow the electronic structures to be visualized and the stability to be made credible even without appealing to any quantitative calculations. Pauling has similarly avoided molecular-orbital pictures almost throughout, and has thus given no hint of many developments in the semi-quantitative treatment of bonding in the last two decades. To take another example, there is only slight recognition of the ligand field theory of the spectra and magnetism of metal complexes, although this would seem to have been a natural addition to the excellent section on magnetism in the early edition. Much more is known now about these subjects that might have been put in to bring the book up to date.

It is a measure of Pauling's immense success with the earlier editions that one somehow expects this great chemist to bring off a new *tour de force* in this one. The expectation is unreasonable. The book does, however, remain of very great value, powerfully individual and illuminating in a way that is rare in scientific books. This is an added reason why undergraduates, whom Pauling has had specially in mind in this version, should read it. Those who do will get something of the same awakening as did first-edition readers 20 years ago.

D. P. CRAIG

OXIDATION–REDUCTION POTENTIALS OF ORGANIC SYSTEMS. W. Mansfield Clark. Pp. xi + 584. *London: Baillière, Tindall & Cox Ltd*, 1960. 108*s*.

This is a rather unusual book. The author, who has done a great deal of work in the field, attempts to keep together the more critically important techniques used in gathering oxidation–reduction data, the data, the theoretical meanings of the data and the limitations of their uses. The essential theme is one of thermodynamics, which is dealt with from first principles. The text throughout contains lengthy descriptions of historical origins, and the aim has been to present a readable account of the whole subject. In some cases, this has resulted in quite simple ideas being presented in a verbose and involved way that might tend to confuse the beginner for whom the book is obviously intended.

Apart from these limitations, which are confined mainly to the first 150 pages or so, the rest of the book serves the very useful purpose of giving for the first

time in one place redox data on a large number of organic systems. The volume deals only with potentiometric methods of investigation, and the aim has been to present carefully chosen examples which reveal unique features that can be studied by this method. There are chapters devoted to the rectification of experimentally observed redox titration curves, and the construction of equations to account for the formation of dimers, intermediate free radicals and co-ordination compounds. It is shown that much of the interpretation of data found in the early literature failed because of the assumption of a compulsory one-electron change. Chapters on liquid-junction potentials and the standardization of potential and pH scales are followed by a description of the experimental methods. This is particularly well written and shows the hand of a master of the techniques involved in the potentiometric study of redox systems. After a discussion of the reliability of redox potentials, the rest of the book is devoted to compilations of data. There are more than 100 tables of data covering some 162 pages. Individual redox systems are critically discussed and the volume is a most useful source of reference for workers in the field.

It is difficult to imagine a worker wishing to enter such a specialized field with so little knowledge of physical chemical principles. The inclusion of lengthy expositions of these has meant that other important aspects have been excluded. Polarography is dismissed in seven pages and irreversible systems, which are so important in the organic field, are not considered at all.

The book is commendably free from typographical errors and is well produced. It contains an extensive bibliography and will prove an invaluble source of reference for workers interested in potentiometric studies of organic redox systems.

G. H. NANCOLLAS

PRINCIPLES OF RADIOISOTOPE METHODOLOGY. G. D. Chase. Pp. viii + 286. *Minneapolis: Burgess Publishing Co.; London: The Mayflower Publishing Co. Ltd*, 1960. 48*s*.

This book is essentially a laboratory manual which, as the preface reveals, is intended as an 'introductory guide for the technician, the advanced medical student and the researcher using radioisotopes in his work.' The first two categories should only need a limited selection of the experiments but the research chemist, who requires a more comprehensive introduction to tracer techniques, could work through the whole course with advantage. The level of training required to perform these experiments with some understanding is roughly equivalent to the first year of a British undergraduate's course in mathematics, physics and chemistry. Nevertheless, this practical course would only provide the student with a very superficial acquaintance with many basic topics; a true understanding would require much longer formal training.

The first seven chapters of this book, occupying 146 pages, deal with experiments designed to illustrate the basic properties of radioactive isotopes, together with instrumental techniques associated with their detection. Chapters 8 and 9 deal with the application of radiotracer techniques to chemistry (45 pages) and biology (19 pages). Finally, there are extensive appendixes (57 pages) with outlines of lectures to supplement the practical course, a glossary of terms employed in radioisotope work, several tables of data, some problems for the student (without answers) and an exhaustive list of reference books published before 1959. The arrangement of subject matter is fairly logical, although the postponement of statistics until the fourth chapter and the discussion of the use of isotopes as tracers in the last chapter might be questioned. The standard of writing is generally good but occasionally the pedant might be reduced to apoplexy, as when it is stated that in a set of experimental observations there is 'little likelihood' of observing the mean value itself.

There is a standard arrangement for each chapter, with a brief general introduction followed by several sections, each of which is devoted to a particular experiment. Normally a section is divided into Objectives, Theory (which is usually sufficient to render the experiment intelligible without extra reading), Procedure and Calculations. Effective and extensive use is made of line drawings. The chapters on 'Properties of Radiation' and 'Standardization Techniques' are very well presented, but the chapter on 'Instrumentation' is the least satisfying of all since some experiments are designed to operate with specific commercial instruments which may not be encountered outside North America. The use of vibrating reed electrometers, pulse counting of gases, and γ-spectrometry are important techniques which are omitted from this chapter. The measurement of dose rates, a topic of universal importance, receives scant attention.

The experiments designed to illustrate chemical applications are well-tried, conventional examples. They include studies of co-precipitation, solvent extraction, electrodeposition, chromatography, distillation, ion-exchange, solubility product, exchange reactions and dilution analysis. Biological applications include *in vitro* and *in vivo* assay of biological materials, autoradiography and protein electrophoresis.

This book is probably the best-balanced practical manual which is at present available on the subject, and it is certainly good value for money.

D. R. STRANKS

THE USE OF ORGANIC REAGENTS IN INORGANIC ANALYSIS. A. I. Busev and N. G. Polianskii. Translated by J. T. Greaves. Pp. 76. *Oxford: Pergamon Press Ltd*, 1960. 21*s*.

This booklet represents an account of developments in the evolution and use of organic reagents in inorganic

analysis over the past 70 years. The contents are divided into two sections. The first 22 pages constitute a general discourse on reagents new and old under the title 'General problems in the application of organic reagents,' and the second chapter (pp. 38), on 'Important methods of determining elements using organic reagents,' is an account of applications classified according to the occurrence of metals within the periodic system. The remaining 16 pages are devoted to an extensive bibliography.

Unlike most books, this monograph should perhaps be judged from two viewpoints. These are (*a*) the special contribution it may make in respect of its (for us) unusual source, (*b*) its intrinsic merit. Several generalities can first be stated, however. For example, the text reviews the output of 470 papers in the space of only 60 pages, and consequently little detail is given in most instances; in places the style is so disjointed that the book gives the impression of having been hastily compiled by scissors and paste from a card index system. This is unpleasant, but does not detract from the scientific value of the text. It should be noted that work on the complexans and on chromatographic reagents is omitted in view of the recent publication of monographs on such topics. Some authors' names are Russianized in the text though correctly reported in the bibliography.

Judged from the first viewpoint this monograph makes a very valuable contribution, since it reviews most of the work done on this subject in the Soviet Union. This is particularly valuable as sometimes detail is given which is not available in the abstract literature. On this score alone the monograph is well worth while. One cannot be quite so enthusiastic from the second viewpoint, however, for the text is largely uncritical and, surprisingly, one finds it makes no mention of some of the most selective reagents so far devised outside the U.S.S.R. In some instances, new discoveries are attributed to authors working much later than the originators.

The picture presented is largely qualitative, and for the reviewer it is a matter of regret that the development of quantitative theory governing the structure and reactions of organic reagents, which is attributed in references to distinguished Russian analytical chemists, is not discussed in any way.

In my opinion this booklet, despite its shortcomings, is a valuable contribution to the literature of analytical chemistry, particularly in view of the light it sheds on recent progress in the Soviet Union.

T. S. WEST

PRINCIPLES OF DAIRY SCIENCE. E. Vanstone and B. M. Dougall. Pp. 238. *London: Cleaver-Hume Press Ltd*, 1960. 25*s*.

This concise little book was apparently designed to meet the basic requirements of students, to be a reference book for dairy farmers and to serve as a laboratory manual for those engaged in the dairy industries. There is no doubt that it achieves the first and last of these objectives. Whether it will be used to any appreciable extent by milk-producers is questionable.

The authors are both teachers of great experience at Agricultural College level and it was to be anticipated that they would produce a textbook which is, in the main, admirably suited to their students. Although the student working for a degree in agriculture may find its uses more limited, it does contain a good deal of information not very easily obtained from the sources normally available to him.

In Part I, the chemical components of milk, including the vitamins and enzymes, are dealt with in considerable detail. It may, indeed, be thought that an understanding of at least some of this would involve a knowledge of organic chemistry which the average unmatriculated student is rather unlikely to possess. The remainder of this Part is devoted to dairy technology, the making of butter and cheese and the manufacture of dried and condensed milk being adequately described. There are, in addition, chapters on water supply and on the law as it applies to the dairy industry. This last chapter, which brings together the various enactments relating to milk and its products, is particularly useful.

Part II is devoted largely to the analysis of milk and milk products. Here the authors, both chemists, are on their own ground and have done an extremely competent job. This is perhaps the best part of the book and it provides a sound basis for the claim, made in the preface, that the volume should serve as a laboratory manual for those concerned with the various dairy industries.

Only one serious criticism can be directed at this book. In Chapter 2, which is concerned with the feeding and management of dairy cows, there are listed a number of production rations, some of which would be acceptable neither to the nutritionist nor to the cowman. To feed 14 lb of soya-bean cake to a 4-gallon cow would be inexcusably extravagant and, moreover, somewhat risky. This apart, the book is to be recommended. It is well presented, most readable and very moderately priced.

B. THOMAS

α-AMINOALKYLIERUNG. DARSTELLUNG UND EIGENSCHAFTEN DER KONDENSATIONSPRODUKTE H-ACIDER STOFFE MIT CARBONYLVERBINDUNGEN UND AMINEN. H. Hellmann and G. Opitz. Pp. xi + 336. *Weinheim: Verlag Chemie, GmbH*, 1960. DM 36.

The Mannich reaction, in its most general sense, has many synthetic applications, both in the production of amine derivatives and in their subsequent utilization for other reactions. This volume is a very thorough and systematic summary of the scope of the processes

involved. The various possible components of reaction are discussed, and there are comprehensive tables of compounds examined and nearly 2,000 references. Discussions of the mechanisms involved are accurate so far as they go, but the book might have had an enhanced general interest had they been more extensive and more fundamental. As it is, the book is a monograph in the German tradition, not very easy to read, but with an enormous amount of valuable information and a strong practical bias.

A. J. BIRCH

ADVANCES IN CLINICAL CHEMISTRY. VOLUME III. Edited by H. Sobotka and C. P. Stewart. Pp. xiii + 400. *New York: Academic Press Inc.; London: Academic Books Ltd*, 1960. $12.

The present volume is the third of an annual series intended to present reviews of subjects of interest both to the clinical biochemist and to the research-minded clinician. Like its predecessors, it succeeds in this purpose very well.

Perhaps the most directly valuable review in the book is that by Reinhold on serum flocculation tests and their application to the study of liver disease. These tests depend essentially but not exclusively on the presence of increased amounts of γ-globulin in the serum of patients with modified liver functions. They are very widely employed on an empirical basis without any understanding either of their mechanism or of their pitfalls. Reinhold provides an excellent account of the mechanism from the standpoint of modern protein chemistry, and continues with a detailed examination of their practical application and of the results obtained with the most important methods. The review is essential reading for all who have to use these tests.

J. B. Brown gives an authoritative review of the estimation and significance of the oestrogens in human material. I disagree with Brown in his estimate of bioassay methods as laborious and outdated. For many purposes the gynaecologist is concerned with the production of oestrogenically active material by functional ovaries, and for this purpose bioassays may provide the required information with less labour than that necessary to obtain specificity in the chemical methods. However, Brown's review provides an excellent short account of the biochemistry of the oestrogens and an unequalled collection of results in various conditions.

A work of this nature must necessarily include reviews of concern to the clinical biochemist, who will only exceptionally have the opportunity to investigate them experimentally; the Editors have correctly continued to include these reviews for their intrinsic interest. In this volume the reviews by Girdwood on folic acid and by Gräsbeck on Vitamin B_{12} come into the category. They provide excellent short reviews of the chemistry and biochemistry of these substances, followed by detailed accounts of their estimation in biological fluids, and the findings to be expected in various pathological states. Gräsbeck's review also includes a summary of the present state of knowledge of Castle's 'intrinsic factor.' Many biochemists in non-clinical fields will find these articles of particular value.

Schwarz contributes an account of the application of infra-red methods to the identification of certain tissue constituents, particularly lipids. Here again, although the facilities for this type of work are rarely available in European clinical laboratories, the review is timely in drawing attention to the possibilities inherent in applying physical methods to biological problems.

Continuity with last year's volume is provided by Arias's review on the chemical basis of kernicterus, which is closely linked with Billing's earlier review on the bile pigments.

I consider that the increasing pace of clinical research in this country will render these volumes indispensable in any medical library.

C. J. O. R. MORRIS

PRINCIPLES OF CHEMICAL THERMODYNAMICS. C. E. Reid. Pp. xii + 306. *New York: Reinhold Publishing Corporation; London: Chapman & Hall Ltd*, 1960. 63*s*.

It is perhaps inevitable that books on chemical thermodynamics should resemble the doctor's prescription—the mixture as before—and that they should differ from one another in the proportions rather than the nature of the ingredients. Professor Reid's book represents a new balance between pure thermodynamics on the one hand, and mathematics, molecular models, statistical mechanics and numerical applications on the other hand. The bias, on the whole, is mathematical. Thus, while only two tables of data appear throughout the book, there is a whole chapter on Jacobians and general methods of transformation. The presentation, usually clear and well-written, suffices to enable the reader to solve the problems posed at the ends of the chapters. The author is among the very few writers who use the phrase 'order of magnitude' correctly, and eschews writing 'of the order of' when he means 'about.'

In certain sections the book is not as modern as one is entitled to expect. For example, although the dissociation energy of carbon monoxide into gaseous atoms is given correctly in a numerical illustration of Hess's law, the paragraph concludes by stating that 'some values as low as 160 kilocalories have ben reported.' The reviewer is not aware of the source of this false datum. Herzberg in 1937 gave 210—a good deal nearer the true value of 254, which, like the heat of sublimation of graphite, is no longer a 'controversial figure.' Less than two pages are devoted to the statistical mechanics of solutions.

It is a little difficult to describe the level of this book, though it tallies roughly with the author's aim of providing a text suitable for a student who has had 'a year each of calculus and physical chemistry.'

No book on thermodynamics will satify every reader on the question of notation. The symbols adopted here are now used almost universally, namely A for the Helmholtz free energy, G for the Gibbs free energy (a welcome departure from F), H for the heat content or enthalpy, U for the internal energy and S for the entropy of any system. The American convention on molar properties has hitherto been to use small capitals, *e.g.* H for the heat content of one gram-mole. Partial molar properties have been denoted by the same symbol with a bar above it, *e.g.* $\bar{H}$. The custom has fallen into desuetude, chiefly on grounds of typographical convenience, and because H may be used to denote the heat content of any system, including a particular system containing only one gram-mole of a pure substance. The simple symbol H_i may be used to denote the partial molar heat content of component i in the system. Professor Reid, however, uses g, h and so on for the molar, or partial molar, Gibbs free energy and enthalpy respectively. Though it has found some support in this country, the choice appears to the reviewer to be unfortunate for many reasons.

The symbol σ for $h^2/8\pi^2IkT$ on p. 128 may cause confusion in the minds of many readers because experts on statistical mechanics have used it, in precisely this problem, to indicate the symmetry number. Af for affinity will hardly be tolerated by chemists, who would regard it as the product of A and f.

There are relatively few typographical errors, such as Thompson for Thomson (p. 44), thermale for thermal (p. 149) and hcküel for Hückel (p. 207).

A few corrections and minor adjustments would greatly improve the value of this book which, as it is, promises to be helpful to a wide circle of readers.

One must, presumably, move with the times, getting used to clapeyron, einstein, kirchhoff and planck at the top of the pages, and drawing comfort from the fact that the old-fashioned way of printing a man's name is still retained in the text.

E. A. MOELWYN-HUGHES

RADIOACTIVE WASTES: THEIR TREATMENT AND DISPOSAL. Edited by J. C. Collins. Pp. xxi + 239. *London: E. & F. N. Spon Ltd*, 1960. 55*s*.

The increasing number of nuclear power stations, the use of radioactive isotopes in industry and medicine and the testing of nuclear weapons have all caused the treatment and disposal of radioactive wastes to be of vital concern to the community. These wastes may be solid, liquid or gaseous, and their disposal must be carried out so that they cause no danger to present or future generations. No amount of energy or expense, therefore, must be spared to ensure this freedom from danger.

This excellent book is a symposium by seven practical experts and is edited by J. C. Collins, formerly a member of the Health and Safety branch of the United Kingdom Atomic Energy Authority. It is hoped that it may prove valuable to all, whether familiar with radioactivity or not.

The first chapter deals comprehensively with atomic structure and the nature of radioactivity. Subsequent chapters treat the sources of radioactive wastes, the hazards of radiation, and the measurement of radioactivity by ion collection at charged electrodes, by scintillation methods and by photographic film detectors.

The second half of the book gives detailed accounts of the treatment and disposal of liquid and solid wastes, and the controlled discharge of gaseous effluents into the atmosphere. Liquids are treated by storage and concentration, ion exchange, chemical coagulation, biological treatment or controlled discharge into rivers or the sea.

There is a valuable chapter on the law relating to radioactive wastes, which applies to the U.K.A.E.A., to licensed operators of nuclear reactors and also to other users of radioactive material. A Bill is being enacted making it illegal for persons who use radioactive material to dispose of waste except in accordance with authorization from the appropriate Minister—in England, the Minister of Housing and Local Government.

Seven pages are devoted to symbols and abbreviations used in the text, and 11 to a glossary of terms necessary to explain the subject matter. There are 167 references to other books and papers.

The book will be of the utmost value, not only to those who wish to become familiar with the subject, but also to the specialist.

W. G. CAREY

HENRY CAVENDISH—HIS LIFE AND SCIENTIFIC WORK. A. J. Berry. Pp. 208. *London: Hutchinson & Company Ltd*, 1960. 35*s*.

Henry Cavendish was recognized during his lifetime as one of the greatest scientists of the day, and his stature was increased after his death by the publication of fundamental researches in electricity, heat and other branches of science which he left in his notebooks.

The author gives a short account of Cavendish's life, and discusses all his scientific work in some detail. The scientific reader who wishes to learn about Cavendish's brilliant contributions to the development of chemistry and physics will therefore find the book of value, and will surely admire the genius and versatility of the shy and nervous millionaire.

This book cannot, unfortunately, be whole-heartedly recommended to the serious student of the history of science, for the author's approach is in some respects unhistorical. In many places he modernizes Cavendish's chemical nomenclature, and this is liable to cause confusion, and, while Cavendish's work is well described, the discussion of its significance is not always sound. Two examples may be given from the chemical work. After giving a good account of Cavendish's experiments

on the reaction between inflammable air (hydrogen) and dephlogisticated air (oxygen), the author does not make it clear that Cavendish finally favoured the explanation that the water formed was originally present as a constituent of each gas; and, while Cavendish's analysis of Rathbone-place water was very well done, it is a great exaggeration to describe him as 'the founder of water analysis'.

The book is therefore to be consulted for accurate descriptions of Cavendish's work, but some of the author's conclusions are to be treated with caution.

W. A. SMEATON

TECHNOLOGY OF NON-METALLIC COATING. A. Ya. Drinberg, E. S. Gurevich and A. V. Tikhomirov. Translated and edited by E. Bishop. Pp. xvi + 531. *Oxford: Pergamon Press Ltd*, 1960. 80*s*.

It is always interesting to learn of technical progress taking place in the U.S.S.R., and Mr Bishop is to be commended for his translation of this book, which brings us knowledge of Russian technology in paints and varnishes. Since the original work was written for students of chemical engineering, its scope is wide, corrosion and the equipment used for application of coatings receiving thorough treatment. In many ways the book is a combination of the old and the new in paint technology. Pictures of brushes are coupled with equations for the amount of fresh air entering a convector drier, and a formula for water paints containing rye flour and common salt is included with details of the lastest heat-resistant titanate coatings. On account of this very wide coverage, all who are interested in non-metallic coatings will find some technical data in the text of which they were previously unaware.

The book is thorough and fundamental in its treatment. Besides the usual electrochemical theory to explain corrosion, surface chemistry is used to help explain wetting and kinetic theory the evaporation of solvents from coatings. The rheology of coatings is discussed with an appreciation of the all-important property of high or super elasticity. The authors pass easily from the pure to the applied, and give a very practical account of the whole field of surface preparation and the equipment necessary for large-scale application and drying of coatings. Since the text includes authoritative accounts of such extremes as steric hindrance in polymer formation and the design of spray guns, one is presumably benefiting from the combination of authors.

All the resins, pigments and solvents used by the Russian paint industry and mentioned in the book are known here. The newer resins such as epoxy, polyester and polyurethane are used in Russia, but pigment variety is more limited, the need to protect presumably being more important than the need to decorate. Quite a fair amount of information is given on the formulation of coatings, and the reader is not told that a 'synthetic' resin is used. It is understood that the standard specifications mentioned are available here. The work has been translated into good plain English.

A. S. FREEBORN

CHEMICAL ENGINEERING MATERIALS. 2nd Edition. F. Rumford. Pp. x + 384. *London: Constable & Co. Ltd*, 1960. 32*s*. 6*d*.

This is the second edition of Dr Rumford's by now well-known work and, needless to say, it is very welcome. The teaching of materials to students of chemical engineering is beset with difficulties. If the fundamentals of corrosion can be dealt with in a congenial and fully educational manner, the attempt to deal with practical applications is complex and can all too easily lead to a catalogue of industrial uses which is not only dull but of no educational value at all. Dr Rumford steers a course between these with very happy results, largely because the book is extremely readable. This quality is all too often missing from technical and scientific literature of all kinds.

The new edition is changed in only a few respects. Especially important are the changes made in the last chapter, now entitled 'High Polymers' and devoted to the wide range of 'plastics' whose use is now increasing at an expanding rate. Attention is given not only to rubber and the reinforced plastics, but to the wide range of thermoplastic materials and to the many varieties of woven materials of such great importance. There is no doubt that this chapter, in the future editions we look forward to, will be extended and indeed split into a number of chapters as the field expands.

D. M. WILSON

PUBLICATIONS RECEIVED

PERIODICALS IN THE CHEMICAL SOCIETY LIBRARY. Pp. 48. *London: The Chemical Society*, 1960. 5*s*.

ADDENDUM 1960 TO THE BRITISH PHARMACOPOEIA 1958 (official from 1 March, 1961). Pp. xxi + 83. *London: Pharmaceutical Press, for the General Medical Council*, 1960. 30*s*.

A CONCISE SCHEME OF VOLUMETRIC ANALYSIS. J. H. Skellon. Pp. vi + 58. *London: Sir Isaac Pitman & Sons Ltd*, 1960. 6*s*. 6*d*.

MILK COMPOSITION IN THE UNITED KINGDOM. Report of an Interdepartmental Committee. Pp. 92. *London: H.M.S.O.*, 1960. 5*s*.

SIXTEENTH ANNUAL REPORT OF THE BRITISH COKE RESEARCH ASSOCIATION, 1959. Pp. 40. *Chesterfield: The British Coke Research Association*, 1960.

CENTRAL ELECTRICITY GENERATING BOARD ANNUAL REPORT AND ACCOUNTS, 1959–60. Pp. 172. *London: H.M.S.O.*, 1960. 9*s*.

CITY OF MANCHESTER RIVERS DEPARTMENT REPORT FOR THE YEAR ENDED 31 MARCH, 1960. Pp. 51.

Institute Affairs

EXAMINATIONS, APRIL, 1961

Graduate Membership, Part II

The theoretical section of the examination, Part II (a), will be held in London and Newcastle upon Tyne and, if required, in other centres on **Monday and Tuesday, 10 and 11 April, 1961.**

Practical exercises will be carried out in London and in Newcastle upon Tyne on **Wednesday to Saturday, 12 to 15 April,** inclusive, and in London on **Tuesday to Friday, 18 to 21 April,** inclusive.

Candidates will be asked to state their preference as to the centre for their theoretical papers and the period and centre for their practical exercises, but it must be clearly understood that no guarantee can be given that their wishes will be met.

Candidates who have not yet been accepted for examination and who wish to present themselves in April should obtain from the Assistant Registrar without delay the prescribed Application Form, so as to allow ample time for obtaining the necessary signatures certifying that they have complied with the Regulations concerning their courses of training. **The completed Application Forms must reach the Institute not later than Wednesday, 11 January.** No application will be considered if received after that date.

The last date for the receipt of Entry Forms is Monday, 13 February. No Entry will be accepted if received after that date.

EXAMINATIONS, OCTOBER, 1960

Postgraduate Diplomas

Entries were as follows:	*Entered*	*Passed*
Branch A: General Analytical Chemistry	2	2
Examiners: Mr R. C. Chirnside, Dr J. Haslam.		
Branch E: Chemistry (including Microscopy) of Food, Drugs and Water	1	0
Examiners: Dr H. E. Archer, Mr T. McLachlan.		
Branch G: Industrial Chemistry, with special reference to Plastics, Rubber and other High Polymers	1	1
Examiners: Dr N. J. L. Megson, Dr W. Preston.		
	4	3

Pass List

Branch A: General Analytical Chemistry:

COBB, Peter George William, A.R.I.C.
WHITWAM, James Trevor Edwin, A.R.I.C.

Branch G: Industrial Chemistry, with special reference to Plastics, Rubber and other High Polymers:

FORD, Peter, B.SC. (LOND.), A.R.I.C.

NOMINATION OF GENERAL MEMBERS OF COUNCIL

In accordance with the provisions of By-Law 23(c) the following General Members of Council are due to retire at the Annual General Meeting on 21 April, 1961, and are ineligible for re-election in that capacity or for election as District Members of Council:—

George Dring, M.A., B.SC., M.I.CHEM.E., F.P.I.
Herbert Henry Hodgson, M.A., B.SC., PH.D., F.S.D.C.
Sir Harry Work Melville, K.C.B., PH.D., D.SC., F.R.S.
Mamie Olliver, M.SC.
Frank Arnold Robinson, M.SC.TECH., D.SC., LL.B.
Arthur Joseph Victor Underwood, D.SC., M.I.MECH.E., M.I.CHEM.E., F.INST.PET., F.INST.F., M.CONS.E.
Ernest James Vaughan, M.SC., A.R.C.S., D.I.C., F.I.M.

Seven General Members of Council are therefore to be elected at the Annual General Meeting in 1961 to fill these vacancies. The Council will in due course make nominations for this purpose under By-Law 25(d). Other **nominations under By-Law 26** are now invited and must be delivered at the Institute **not later than 1 February, 1961.**

By-Law 26 reads:—

26 (1) Any ten corporate members, not being Members of the Council, may nominate an eligible Fellow as a candidate for election as a General Member of the Council but no corporate member shall concur in nominating more than one such Fellow at any particular election.

(2) Any nomination made under this By-Law... shall be in the following form:—

'We, the undersigned, being corporate members of the Royal Institute of Chemistry do hereby certify that A.B. of
(registered address), a Fellow of this Institute, is, in our estimation, a fit and proper person to be a General Member of the Council of the Institute, and we do hereby nominate him as a candidate for election as a General Member of the Council.'

(3) Any such nomination may consist of several documents in like form, each signed by one or more corporate members, and shall be accompanied by a statement by the candidate that he is willing to accept such nomination.

When considering making nominations under By-Law 26, corporate members may wish to be reminded that :—

(*a*) Nominations for District Members of Council were invited in October (*see J.*, 366), and the notice included a complete list of present District Members of Council showing which were ineligible for re-election.

(*b*) Present General Members of Council who are due to continue in that capacity after the Annual General Meeting, 1961, are :—

Until the A.G.M., 1962 : Mr E. H. Coulson, Dr D. C. Garratt, Sir Christopher Ingold, Professor H. N. Rydon, Dr C. Simons, Professor R. L. Wain, Dr D. Woodcock.

Until the A.G.M., 1963 : Dr H. J. Barber, Dr R. W. Bolland, Professor W. Bradley, Dr C. M. Cawley, Mr J. E. Davis, Dr C. Forrester, Professor L. Young.

(*c*) It will be for the Council to make nominations in due course under By-Law 22, to fill vacancies among Officers that will occur at the Annual General Meeting, 1961, through the retirement of the following :—

President :

Ernest Le Quesne Herbert, B.SC., F.H.-W.C., M.I.CHEM.E., F.INST.F., F.INST.PET. (who will become Vice-President, *ex officio*).

Vice-Presidents :

Clifford Walter Herd, B.SC., PH.D.
Charles Kemball, M.A., PH.D.
Clifford Paine, B.SC., F.S.D.C.

The following Vice-Presidents are due to continue in that office until the A.G.M., 1962 : Professor H. J. Emeléus, Professor R. A. Morton and Dr G. R. Ramage.

PROPOSED NEW GRADE OF MEMBERSHIP

It was reported last month (*J.*, 398) that in view of indications of widespread support in principle for the introduction of a Licentiateship grade of membership, the Council had decided to study further the basis on which such a grade might be constituted. An outline of possible provisions for a Licentiateship grade was given in the Council's statement published in April (*J.*, 122-125), but several points of principle, as well as many of detail, had then been left open.

These questions have now been discussed at length, in the light of the numerous helpful comments and suggestions put forward at meetings, especially those of Local Sections, and in correspondence. The result is that the Council, on the advice of the Study Group on Qualifications, have now agreed on the terms of a definite PROPOSAL for the establishment of a Licentiateship grade, which they believe would serve the needs of those who would be eligible for admission to it, while safeguarding the status and interests of members in existing grades.

As has already been pointed out, the introduction of a Licentiateship grade would entail changes in the By-laws, and such changes could only be made if appropriate formal resolutions submitted to a General Meeting were passed by a two-thirds majority. The Council have concluded that before committing themselves to convening a Special General Meeting for this purpose it would be desirable to sound the opinion of the general body of corporate members on the proposal, by means of a REFERENDUM. A memorandum has accordingly been prepared, setting forth the background of the proposal, its terms and conditions, and its implications, and arrangements are being made to send to each corporate member a copy of this memorandum, with a voting paper on which to record approval or disapproval of the proposal. These papers will be sent, separately from the *Journal*, but with the Annual Subscription Notice (*see* p. 436), at or before the end of December.

In the light of the response to this referendum, the Council will consider whether or not to proceed with the submission of resolutions for altering the By-laws at a Special General Meeting in London next year.

ANNUAL CONFERENCE, SOUTHAMPTON
20-22 April, 1961

More than 350 members have given provisional notice of attendance at the Annual Conference to be held in Southampton next April.

Although vigorous efforts are being made to overcome difficulties caused by limitations of space and seating accommodation, it is feared that it may be impossible to meet the wishes of all those who eventually confirm their intention to participate in the Conference unless their number is much smaller than is expected.

As already announced, the detailed Programme of Events, registration forms and other information will be sent, in January, 1961, to all those who have given provisional notice of attendance, and tickets for the various events will subsequently be allocated in the order in which the questionnaire forms were received.

THE ELEVENTH DALTON LECTURE

On Friday, 28 October, the Eleventh Dalton Lecture was given by Sir Harry Melville in the Manchester Town Hall. The lecture, 'Chemistry in Everyday Life —The Contribution of the Department of Scientific and Industrial Research,' is being distributed shortly. Before the lecture the Lord Mayor of Manchester, Alderman Arthur Donovan, J.P., entertained Sir Harry Melville, Mr E. LeQ. Herbert, *President*, Dr H. J. T. Ellingham, *Secretary and Registrar*, Dr L. R. Ridgway, Chairman, Manchester and District Section, and other officers in his private suite in the Town Hall.

Mr LeQ. Herbert took the Chair at the lecture and thanked the Lord Mayor and City of Manchester for the

By courtesy of the Manchester Evening News

Left to Right: Lord James, High Master, Manchester Grammar School; Mr E. LeQ. Herbert, *President;* Dr L. R. Ridgway, Chairman, Manchester and District Section; Dr G. R. Ramage, *Vice-President;* Alderman Arthur Donovan, Lord Mayor of Manchester; Sir Harry Melville, Dalton Lecturer; and Professor W. Mansfield Cooper, Vice-Chancellor, University of Manchester

arrangements and for the interest they take in the Dalton Lecture. In reply the Lord Mayor expressed the City of Manchester's pride in having been the home of Dalton's genius. Sir Harry Melville at once captured the interest of his audience, and took them through the many examples which he was able to give of the contribution of chemistry to our modern life. It was gratifying to see many young people in the large audience, and Sir Harry is to be congratulated on having at the same time held their interest and that of the eminent scientists present.

After the lecture, Sir Harry, Mr Herbert and Dr Ellingham were entertained to dinner by Dr Ridgway. The University of Manchester was represented by the Vice-Chancellor, Professor W. Mansfield Cooper, and the Principal of the College of Science and Technology, Dr B. V. Bowden. The toast to John Dalton was proposed by Mr G. Osgood, who stressed that Dalton was a humble man who had never travelled more than 100 miles from Manchester. On the other hand his work had influenced people all over the world and his principles were used daily in every branch of science. In welcoming the guests, Dr Fletcher hoped that there had been no confusion between another event which took place in Manchester on the previous day, namely the retirement of a certain John Dalton who for many years had been the stage-doorkeeper at the Manchester Palace Theatre. Two of the distinguished guests, the Dean of Manchester, the Very Rev. W. A. Jones, and Lord James of Rusholme, both began their careers as scientists. The Lord Mayor of Manchester responded on behalf of the guests, recalling that Dr Ridgway had received recognition early in his career as a Dalton Scholar. In a gay and entertaining speech the President thanked Sir Harry Melville for his excellent address.

DIRECTORY OF INDEPENDENT CONSULTANTS

As announced in September (*J.*, 334), arrangements are being made for collecting information for a new edition of the Institute's *Directory of Independent Consultants in Chemistry and Related Subjects*. Forms have been prepared on which particulars of eligible independent consulting practices in the U.K. may be entered, and application made for their inclusion in the new edition of the *Directory*.

The detailed conditions of eligibility of practices for reference in the *Directory* are stated on the forms. Briefly they are :—

(i) The control of the practice is vested in one or more Fellows or Associates of the Institute who are, or are included among, the Principals of the practice.

(ii) The practice is not part of, or subsidiary to, any other organization, and its sole or predominant business is the provision of independent consulting services. The provision of such services in chemistry and/or closely related subjects is the sole or predominant activity of the Fellows and Associates who are, or are among, its Principals, and is an essential part of the business of the practice.

It is expected that, before this issue of the *Journal* appears, copies of the relevant forms will have been sent to the Principals of practices that were referred to in the 1955 edition of the Directory (except those known to have ceased), and to each Fellow or Associate who has given notice of having since established a practice which, on the evidence given, may satisfy the conditions of eligibility. If there are other corporate members, in control of practices that appear to satisfy these conditions, who have either not applied for the appropriate forms or not received them by 19 December, they should communicate with the Secretary of the Institute, giving brief particulars of the practice.

MELDOLA LECTURES

At the Royal Institution, on 9 November, Dr J. I. G. Cadogan and Dr T. C. Waddington received their Meldola Medals at the hands of the President, Mr E. LeQ. Herbert. Having indicated the nature of the award, the distinction it conferred and some of the achievements of past Medallists, Mr Herbert called on Dr Waddington to give his lecture on 'Liquid Hydrogen Halides as Ionizing Solvents.' The vote of thanks was proposed by Dr Peter Gray.

After the lecture the annual dinner of the Meldola Society was held at Brown's Hotel, the Society of Maccabaeans being represented by Sir Louis Gluckstein.

Dr J. I. G. Cadogan had already delivered his lecture, entitled 'Recent Developments in Free Radical Addition Reactions' in the chemistry theatre, University of Manchester, on 1 November. On that occasion Dr L. R. Ridgway, Chairman of the Manchester and District Section, deputized for the President. Professor F. Fairbrother proposed the vote of thanks for this stimulating lecture.

Both lectures will be published early in 1961.

LECTURES, MONOGRAPHS AND REPORTS

The 1960 series will be completed with the distribution later this month of Nos 3, 4 and 5, the last of which is regarded as a 'double' issue.

No. 3. *Energy Exchange in Interactions between Ions and Molecules*, by V. N. Kondratiev. 4*s*.

This is the full text of the Second Humphry Davy lecture, delivered by Professor V. N. Kondratiev, of the U.S.S.R. Academy of Sciences, on 12 October.

The lecture deals mainly with mass spectroscopic evidence of energy exchanges taking place during reactions between ions and molecules. It is a subject of growing importance, with applications in the study of combustion phenomena, irradiated systems, free radicals, catalysis and other fields. Both symmetrical and unsymmetrical charge transfers are considered, together with factors of importance in obtaining values for the proton affinities of molecules and in the elucidation of ionization mechanisms.

No. 4. *Chemistry in Everyday Life*: *The Contribution of the D.S.I.R.*, by Sir Harry Melville. 4*s*.

The Eleventh Dalton Lecture, with the above title, was delivered by Sir Harry Melville at Manchester on 28 October (*see* p. 434).

As examples of the way in which the D.S.I.R. contributes to everyday affairs, Sir Harry considers important developments that have resulted from the study of ion-exchange resins, radio-isotopes, the auto-oxidation of fats, synthetic detergents and, finally, the factors involved in the skidding of vehicles and possible means of securing increased safety.

No. 5. *Sugar and its Industrial Applications*, by L. F. Wiggins. 5*s*. 6*d*.

This Monograph has been specially written for the series by Dr Wiggins, who worked for several years with the late Sir Norman Haworth and Sir John Simonsen. His main themes are developments in the chemistry of sucrose since World War II and its actual and potential uses as a raw material available for exploitation by the chemical and allied industries.

The sugar industry, besides producing a pure organic chemical on a scale that is approached by no other substance, also accumulates vast quantities of 'waste' materials. Later sections of the Monograph deal with actual and potential uses of bagasse, of filter cake as a source of wax and other materials, and of molasses. The text is supported by some 150 references.

Annual Subscriptions, 1961.—Members are reminded that annual subscriptions for 1961 are due on 1 January. The formal notice and attached payment form will be sent to all members, separately from the *Journal*, at or before the end of December. For corporate members this notice will be accompanied by the Annual Report of the Benevolent Fund, with the Appeal, and by the Memorandum and Voting Paper relating to the Referendum on the proposal for introducing a Licentiateship grade of membership (*see* p. 434).

Institute Representatives.—The following members have been nominated to serve on advisory committees:

Mr J. H. Wood, *Fellow; Manchester and District Advisory Council for Further Education*: *Post-Advanced Chemistry Advisory Committee.*

Mr G. H. Macadam, *Fellow*; *Treforest, Glamorgan College of Technology*: *Chemistry and Chemical Engineering Advisory Committee.*

Dr H. E. Hallam, *Associate*; *Swansea College of Technology*: *Chemistry and Metallurgy Advisory Committee.*

Monographs for Teachers.—A reprint of No. 3, *Principles of the Extraction of Metals* by D. J. G. Ives, will shortly be available. Those who have already purchased

copies may wish to note that the only correction occurs on page 8. In the bottom equation, for C_p read $\triangle C_p$, as indicated in the line immediately above the equation.

Index of Chemistry Films.—A new edition is in the hands of the Printers, and is scheduled for publication in January, 1961. It will contain details of approximately 1,250 films and 300 filmstrips, an increase of 50 per cent over the first edition. Dates of production are being included where known. The price is 5*s*.

Binding of Journals and L.M. & R.—Members and subscribers are reminded of the special arrangements for the binding of Journals in green buckram at the price of 19*s*. 6*d*. per annual volume, including return postage. Those making use of this service are advised not to send Volume 84 (1960) for binding until they receive the *Annual Report of the Council* for the year ended 30 September, 1960, which will be printed in the new format, and should be included in this volume.

Arrangements have also been made for the binding in grey cloth of *L.M. & R.* for 1959-60 in one volume, at 11*s*. 6*d*.

All inquiries and matter for binding should be addressed to W. Heffer & Sons Ltd, Hills Road, Cambridge.

PERSONAL NOTES

News of Hon. Fellows

Sir John Cockcroft, O.M., *Nobel Laureate*, has been elected an Honorary Fellow of the National Institute of Sciences, India.

Professor Arne Tiselius, FOR.MEM.R.S., *Nobel Laureate*, has been appointed president of the Nobel Foundation.

Honours and Awards

Mr R. H. Atkinson, *Fellow*, was presented with the Johnson Matthey Medal of the Institute of Metal Finishing on 5 December.

Mr S. C. Britton, *Fellow*, received the Westinghouse Prize of the Institute of Metal Finishing, jointly with Mr M. Clarke, on 5 December.

Dr G. R. Chaudhry, *Fellow*, has been awarded the degree of D.Phil. for studies on the chemistry of cucurbitacins and allied natural products at Oxford, and has returned to India.

Professor J. M. Robertson, F.R.S., *Fellow*, has been awarded the Davy Medal of the Royal Society for his pioneering work on analysis of crystal structure, especially of organic compounds.

Societies and Institutions

Dr R. H. Marriott, *Fellow*, was elected President of the International Federation of Societies of Cosmetic Chemists at its second council meeting recently.

Association of Clinical Biochemists.—The following *Fellows* have been elected officers of the Association for the session 1960–61 : Chairman, Dr A. L. Latner; Hon. Treasurer, Dr R. Gaddie; Hon. Editor, Mr H. Varley; Hon. Secretary, Dr J. H. Wilkinson.

Royal Society of Edinburgh.—At a statutory meeting of the Society held on 24 October, the following *Fellows* were among those elected officers and members of council : Professor E. L. Hirst, C.B.E., F.R.S., President; Dr M. Ritchie, Secretary to Ordinary Meetings; Professor A. B. Stewart, Member of Council.

Consultant

Mr H. R. Fleck, *Fellow*, is now in practice as a consulting chemist in the U.S.A. His address is P.O. Box 11283, Palo Alto, California. He has been appointed an Extension Lecturer in chelation chemistry at the University of California.

Educational

Miss H. E. D. Alexander, *Associate*, is now at the department of spectrochemistry, Macaulay Institute for Soil Research, Aberdeen. She was formerly assistant spectrographic chemist at the West of Scotland Agricultural College, Auchincruive.

Mr R. G. Barradas, *Associate*, has been appointed research associate, department of chemistry, Royal Military College of Canada, Kingston, Ontario, where he will work with Professor J. R. Dacey, M.B.E., on research in surface chemistry. Mr Barradas was formerly a postgraduate student at the University of Ottawa.

Dr A. D. Campbell, *Associate*, of the chemistry department, University of Otago, is expected to arrive in the U.K. this month for a year's visit.

Dr A. T. Cooper, *Associate*, has been appointed science master at Peterhouse School, Marandellas, Southern Rhodesia, as from January, 1961, and has accordingly resigned from his position as lecturer in chemistry, Department of Pharmacy and Chemical Technology, Durban.

Dr J. C. Craig, *Fellow*, formerly senior lecturer in the department of organic chemistry, University of Sydney, has been appointed to the Chair of Pharmaceutical Chemistry, University of California, San Francisco, and took up his duties on 1 October.

Dr R. L. Forman, *Associate*, latterly a Technical officer with British Nylon Spinners Ltd, is now at the Medway College of Technology, Chatham. (We regret the incorrect announcement on *J*., 402.)

Dr G. K. Gollakota, *Fellow*, director of the School of Basic Science and Humanities, U.P. Agricultural University, Nainital, India, recently took part in an international symposium on spores, held under the auspices of the University of Illinois.

Dr R. M. Haines, *Associate*, is to take up an appointment as senior lecturer at the Institute of Technology, Bradford, on 1 January, 1961. He is at present

lecturer in organic chemistry, Royal Technical College, Salford.

Dr H. M. N. H. Irving, *Fellow*, vice-principal of St Edmund Hall, Oxford, and university demonstrator in the department of inorganic chemistry, has been appointed to the Chair of Inorganic and Structural Chemistry, University of Leeds.

Mr J. A. Kirby, *Graduate Member*, has been awarded a research assistantship in the chemistry department, University of Miami, as from 1 January, 1961.

Dr F. Lester, *Fellow*, has been appointed principal of the College of Further Education, Loughborough, and will take up his duties on 1 January, 1961. He was formerly head of the department of science at Hatfield Technical College.

Dr R. F. Naylor, *Fellow*, Hon. Secretary of the East Africa Section, has been appointed to the Chair of Chemistry at the new University College in Nairobi.

Dr J. O. V. Oubridge, *Associate*, has returned from Canada, where he held a post-doctorate fellowship at McMaster University, Hamilton, Ontario, on a year's leave of absence from the College of Technology, Liverpool. He has now been appointed senior lecturer in inorganic chemistry at the College.

Dr G. D. Parkes, *Fellow*, has been elected to the office of Sub-Warden of Keble College, Oxford.

Dr R. F. Robbins, *Associate*, senior lecturer in organic chemistry, Hatfield Technical College, has been appointed head of the department of science, with effect from 1 January, 1961.

Dr G. S. Siddappa, *Associate*, senior scientific officer in the division of fruit technology at the Central Food Technological Research Institute, Mysore, has been appointed an assistant director of that Institute.

Dr J. H. Skellon, *Fellow*, head of the department of chemistry, Brunel College of Technology, has returned from the United States after a two months' tour under the English-Speaking Union's exchange scheme for technical teachers.

Mr J. D. R. Thomas, *Fellow*, has been appointed senior lecturer at the Welsh College of Advanced Technology, Cardiff.

Dr C. F. Wells, *Associate*, has been appointed lecturer, department of chemistry, University of Birmingham.

Public and Industrial

Mr T. S. Bremner, *Fellow*, has been appointed a director of J. P. Simpson & Co. (Alnwick) Ltd.

Mr R. G. Clark, *Associate*, formerly Assistant Analyst, Kent County Laboratory, is now a development chemist with Petfoods Ltd, Melton Mowbray.

Mr H. M. Davis, *Associate*, has been appointed a member of the board of Southern Analytical Ltd, a company newly formed to carry out the analytical instrument activities of Southern Instruments Ltd.

Mr G. H. Edwards, *Fellow*, director and chief chemist of Weston Research Laboratories Ltd (scientific consultants of Associated British Foods Ltd), has resigned his post to take up a senior appointment in the packaging technology division, research department, Metal Box Co. Ltd.

Dr J. R. Furlong, O.B.E., *Associate*, scientific adviser, Pyrethrum Board of Kenya, has succeeded Dr T. F. West, *Fellow*, at the London office of the African Pyrethrum Technical Information Centre.

Mr L. A. Goodson, *Associate*, has taken a post with Petrochemicals Ltd at their Carrington Research Laboratory, Manchester.

Mr R. Halstead, *Associate*, at present director and vice-president (production), Beecham Products Inc., the group subsidiary in the U.S.A., is to be appointed assistant managing director of Beecham Research Laboratories Ltd.

Dr J. Hamilton, *Associate*, has relinquished his post with Simon–Carves Ltd to take up a senior appointment with British Hydrocarbon Chemicals Ltd at their London office.

Dr J. W. Hancock, *Associate*, is now a research chemist with the Esso Research & Engineering Co., New Jersey. He was formerly with Esso Research Ltd, Abingdon.

Dr M. Josephs, *Associate*, has been appointed market research manager, sales department, Price's (Bromborough) Ltd.

Mr N. F. Kember, *Associate*, is now chief chemist with W. & R. Balston Ltd, Maidstone. He was formerly a principal scientific officer at the National Chemical Laboratory, Teddington.

Mr J. E. Mills, *Associate*, has resigned his position of chemical engineer, South Eastern Gas Board, to join Williams (Hounslow) Ltd as development engineer.

Mr J. Mitchell, *Associate*, has been appointed joint managing director of Ilford Ltd.

Mr W. R. Moon, *Associate*, has joined Industrial Dyestuffs Ltd, Moorgate, as London manager. He was formerly technical research manager, Styrene Co-Polymers Ltd.

Mr D. J. O'Sullivan, *Associate*, formerly chief chemist of Kores Manufacturing Co. Ltd, Harlow, has taken up an appointment as works chemist, Irish Ropes Ltd, Newbridge, Co. Kildare.

Mr A. Owen, *Associate*, has been transferred from the Hercules Powder Co. Ltd, London, to a new company, the Hercules Powder Co. (Australia) Pty Ltd, for three years. The Australian company will be engaged in the manufacture of derivatives of rosin and wax for use in the paper and synthetic rubber industry in Australasia.

Mr H. T. Porter, *Associate*, a chemical engineer with the British Petroleum Co. Ltd, has temporarily joined the Iranian Oil Refining Co., Abadan, South Iran, for a special assignment.

Mr C. Pugh, *Fellow*, has been appointed product research manager of County Laboratories Ltd.

Dr B. Raistrick, F.R.S.E., *Fellow*, has taken up a new appointment with the Central Research Laboratories of Associated Chemical Companies Ltd, Leeds.

Mr G. Rama Rao, *Associate*, is now working with the National Council of Applied Economic Research, New Delhi, as a consulting chemical engineer concerned with the assessing of raw materials for new chemical industries.

Mr C. J. Smith, *Associate*, has been appointed manager of the filter division of Eimco (Great Britain) Ltd.

Mr M. W. Vincent, *Associate*, has been appointed technical sales manager of Blaw Knox Chemical Engineering Co. Ltd. He was formerly head of the process laboratories of Sharples Centrifuges Ltd.

Dr H. K. Whalley, *Fellow*, formerly division director, Distillers Co. Ltd, Chemical Division, is to head the new Overseas Division to be set up by the company, responsible for its oversea chemical interests.

Mr J. R. Windass, *Associate*, has been appointed acting chief chemist of Weston Research Laboratories Ltd.

A. Boake, Roberts & Co. Ltd.—Dr B. T. D. Sully, *Fellow*, who has been acting chief research chemist, has now been appointed chief research chemist. Mr J. A. Dean, *Associate*, is now deputy manager of the research and development department, with executive responsibility for all sections, including chemical engineering.

Imperial Chemical Industries Ltd.—Dr R. Scott, *Associate*, assistant works manager of Dyestuffs Division, Trafford Park Works, has been transferred to the production department, Hexagon House, for special duties. He is succeeded by Mr B. E. Pritchard, *Associate*, formerly head of West Intermediates Department, Huddersfield Works.

Retirements

Mr J. S. Dunn, *Fellow*, has retired from his post as librarian to the Fishing Industry Research Institute, University of Cape Town.

Dr J. Manning, *Fellow*, products technical manager of Imperial Chemical Industries Ltd, Billingham Division, is to retire on 30 November.

Mr G. Middleton, *Fellow*, senior analyst, British Drug Houses Ltd, retired at the end of October.

Mr J. D. Pratt, C.B.E., *Fellow*, has retired as chairman of the British Road Tar Association.

Dr D. Ridge, *Fellow*, has retired from his position as H.M. Inspector, Ministry of Education.

Section Activities

Aberdeen and North of Scotland

Structure of Proteins. At a meeting on 14 October Dr M. F. Perutz, F.R.S., addressed the Section on the 'Structure of Proteins.' He began with a brief introduction to the chemistry of proteins and then passed on to consider the use of X-ray crystallographic methods in elucidating the structure of some proteins that are attracting research interest. The lecturer illustrated how the X-ray data were transformed into graphical representations and then showed three-dimensional models of the proteins.

The meeting concluded with a vote of thanks by Professor W. O. Kermack.

Research at Birmingham. On 8 November Professor J. C. Robb gave a talk on some current research interests in the Department of Chemistry, University of Birmingham. Professor Robb began with a brief outline of the main interests of the physical chemistry section at Birmingham. He then spoke in more detail about two aspects of the work, firstly the measurement of the concentration of hydrogen atoms in a gas by measurement of small changes in temperature and the application of the apparatus to the study of the photodecomposition of ethylene. Secondly, some new ideas on the structure of coal, the results of studying the decomposition of coal heated in a small mass-spectrometer, were discussed. The results could be explained on the basis that coal is a matrix with small molecules trapped in it which are released on increasing the temperature.

After discussion, Dr G. L. Duncan proposed a vote of thanks.

Birmingham and Midlands

The Annual Dinner-Dance of the Section was held at the George Hotel, Solihull, on 23 September. Thanks to the excellent arrangements made by the social secretary, Mr L. H. Vaughan, a most enjoyable evening was had by all.

East Midlands

Proposed New Grade of Membership and Category of Affiliation. As has happened in other regions, the committee has spent some time discussing the Council statement (*J.*, 122). It was felt that there might be a demand within the Region for a special meeting, to be called in the Autumn, to discuss these proposed changes. Members were accordingly asked if they favoured such a meeting and if they had any comments to make. In view of the small number of requests for such a meeting, the Committee decided not to make any arrangements at present.

Electric Factors in Catalysis. The first Autumn meeting of the Section took the form of a conjoint meeting with the College Chemical and Chemical Engineering Society at Loughborough on 13 October. The subject of the lecture was 'The Electronic Factors in Catalysis,' and the speaker Professor D. D. Eley.

Professor Eley introduced his subject by referring to the effect of a catalyst on reaction kinetics. The effect of a catalyst in raising the velocity constant for a reaction is analysed kinetically in terms of frequency factor and activation energy for a reaction, and the main catalytic function in many cases is to lower the activation energy. Up to 1945 various attempts were made to explain certain aspects of catalysis, such as specificity, in terms of fitting the substitute on to certain lattice spacings in the catalyst surface. Since 1945 advantage has been taken of developments in solid-state physics to develop electronic theories of surface interaction. The bulk properties of metals may be explained on either electron-band or valence-orbital theories, and these may be applied to the metal surface and its combination with gases. The first theory offers an explanation of the change of alloy composition on the activation energy of reactions (such as formic acid decomposition, parahydrogen conversion and carbon monoxide–oxygen reaction) catalysed by palladium–gold alloys. The first two substrates donate electrons to the catalyst, and exhibit a low activation energy on Pd-rich alloys, while oxygen in the third reaction accepts electrons from the catalyst and exhibits a high activation energy on Pd-rich alloys. The valence-bond theory leads to a simple calculation of heats of chemisorption in terms of the sublimation energy and work function of the metal. This in turn leads to a correlation of the rate of para–ortho hydrogen conversion with atomic number for evaporated films of metals of the first long period. In seeking more precise theories it will be necessary to measure catalytic reactions on simple lattice planes, since the heat of chemisorption is expected on valence-bond theory to vary from one plane to another, being lowest on the most closely packed planes of highest work function.

After an interesting discussion the meeting was terminated by a vote of thanks, proposed by Mr R. S. Hodson.

Metal Uranates. The Section were guests of the University Chemical Society at Nottingham on 1 November to hear Dr J. S. Anderson, Director of the National Chemical Laboratory, speak on 'Metal Uranates.' The Chairman for the evening, Professor C. C. Addison, first welcomed members of the Institute and of the Chemical Society to the first public lecture in the Chemistry Department's new buildings.

Dr Anderson based his lecture on recent work on reactions in the solid state between KCl and U_3O_8 and showed how infra-red absorption spectra and high-resolution powder X-ray diffraction methods helped in unravelling the secrets of uranate and polyuranate chemistry. Zachariasen first suggested that the uranates are multiple oxides based on UO_2^{++}; in this sense $CaUO_4$ is not analagous to $CaWO_4$, but could be $Ca^{++}(UO_2^{++})O_2$. Dr Anderson illustrated some idealized forms of $(NO_2^{++})O_2^{--}$ layers and remarked on the hexagonal and tetragonal arrangements found in other uranium compounds, the significance of which became more apparent as the story of the uranates was unfolded. Experimentally, the KCl disc method for infra-red spectroscopy of solids could be applied very directly to the reaction between KCl and U_3O_8, whereby potassium uranate is formed. The U_3O_8 was incorporated directly in a KCl disc—an excess of the other reagent—which was heated at about 500° and examined at various stages by infra-red measurements. These provided definite evidence for the existence of two distinct intermediates, termed phase I and phase II, between the compounds U_3O_8 and $K_2U_2O_7$. The existence of phase II was further indicated by X-ray measurements, but this evidence was less satisfactory for phase I, which was never present except in admixture with U_3O_8, phase II or $K_2U_2O_7$. The nature of phase II was first elucidated. It could be isolated, was a uranium(VI) compound, and was found to reduce concentrated dichromate. This suggested the presence of Cl in phase II, and the strong possibility that the latter might have K, U and Cl present in the ratio 2 : 3 : 1. A stoichiometric mixture, corresponding to $K_4U_6O_{19}Cl_2$, was heated and the resulting compound shown to be the same as phase II. Other compounds of this type were also prepared, such as $K_4U_6O_{19}Br_2$ and the corresponding Rb compounds. Phase I was subsequently shown to be $K_4U_6O_{18}Cl_4$.

Dr Anderson went on to show how the structure of these compounds and of the polyuranates could be explained by sheet structures, based on the same hexagonal network of uranium atoms (co-ordinated with oxygen), which persisted through the chemical transformations. In U_3O_8 these uranium–oxygen sheets are tied together by the existence of continuous –U–O–U–O–U– chains; oxidation introduces additional oxygen atoms, together with compensating cations, between the sheets, forming discrete uranyl groups in place of the chains (*i.e.* a stacking sequence O–U–OO–U–OO–U–O and so on). Zachariasen's suggestion that the polyuranates, like other polyanionic compounds, are formed by *condensation* between the simple compounds, and have multi-layered sandwich structures has, surprisingly, been disproved by X-ray methods. The distance between the uranium sheets in the series K_2UO_4 $K_2U_4O_{13}$ is virtually constant. Hence polyuranates are also single-sheet structures; the anionic sheets in this series have the compositions UO_4 $UO_{3\cdot5}$ $UO_{3\cdot25}$ and the polyuranates are formed by abstraction of oxide ions (plus compensating cations)

from the monouranate sheets. In a sense they are defect structures, though the high concentration of oxygen vacancies leads to an ordering and a new (uncertain) co-ordination arrangement.

An interesting discussion followed the lecture, before the Chairman called upon Dr R. F. Phillips to propose the vote of thanks. Dr Phillips took the opportunity to compliment the host Society on their excellent new building and lecture room.

GLASGOW AND WEST OF SCOTLAND

Which? The first meeting of the new session, held in the Royal College of Science and Technology on 14 October, was also Ladies' Night. Mr W. T. Rodgers, of the Research Staff, Consumers' Association Ltd, publishers of *Which?*, lectured on the work of the Association, a non-profit-making organization, wholly independent of government and industry. It was a union of consumers who joined in their own overwhelming self-interest. Mr Rodgers said that in three years the circulation of *Which?* had grown to almost 200,000. He attributed this to conditions of prosperity and a sharp rise in real consumption, to the complexity of products between which the consumer was expected to choose, and to the scale of advertising and the suspicion it aroused. The idealized view of the consumer buying at a price he could pay from the producer selling at the price he could afford had long been out of date. For 100 years legislation had recognized that there were limits to consumer sovereignty. *Which?*, however, had made a unique contribution by concentrating upon testing and rating goods. Mr Rodgers discussed such problems as the high cost of buying goods—over the counter and anonymously—and the cost of testing in independent laboratories. He concluded with the wish that *Which?* could reach an even bigger public.

After a very full discussion, the Chairman, Dr W. A. Caldwell, called upon Mr P. Birrell to propose the vote of thanks.

Addition Polymerization in Solution. At a meeting in the Royal College of Science and Technology on 11 November, Professor P. D. Ritchie, Chairman for the evening, introduced Professor G. M. Burnett of the University of Aberdeen.

Professor Burnett lectured on the polymerization of vinyl acetate and methyl methacrylate in aromatic solvents. Polymerization in benzene, naphthalene, bromobenzene and tetralin was investigated in order to typify the nature of the radical–solvent interaction and also the effect of the solvent on the rate of the polymerization process. It was found that whereas both monomers copolymerize with benzene and tetralin no traces of bromobenzene or naphthalene were found even when radioactive methods were used for their detection. The lecturer stated that in the case of copolymerization the relationship between the composition of the copolymer and of the feed did not obey the usual copolymer composition equation, and it was likely that a reasonably unstable radical adduct was formed in the first stage of the reactions. Benzene and tetralin had a marked retarding effect with vinyl acetate, whereas the reaction followed a fairly normal first-order course for methyl methacrylate. By contrast, polymerization in bromobenzene or naphthalene gave a reaction order of considerably less than unity, indicating that the solvent probably participated in the initiation step. Evidence had been accumulated to this effect, more particularly in the case of naphthalene, where the efficiency of the initiator increased in step with the increase in the fractional rate of the reaction, and in bromobenzene the fractional rate of reaction was related to the square root of the solvent present. Professor Burnett concluded with the observation that the precise chemistry of these processes was very difficult to understand and so far only tentative schemes could be suggested.

After a brief discussion the vote of thanks was proposed by Dr N. Grassie.

HUDDERSFIELD

On 11 November a film evening was held at the Percival Whitley College of Further Education, by the courtesy of the Principal, Dr A. B. Brown. The more serious side of the evening was provided by the U.K.A.E.A. film 'Radioisotopes in Industry' and the D.S.I.R. film 'Insect Pests in Food.' The excellent safety film 'Alert,' by the Shell Petroleum Co. Ltd, provided a link to the entertaining but instructive films 'West Coast Cargo' by Imperial Chemical Industries Ltd, and 'MY Goodness' by A. Guinness and Co. Ltd.

This was the first Section meeting held in Halifax, and it is hoped to hold further meetings there on future occasions. Most of those who attended the meeting had not previously been to the Percival Whitley College, and were most impressed by the fine new building and its facilities.

HULL AND DISTRICT

Forensic Chemistry. On 10 November Dr F. G. Tryhorn, Forensic Science Adviser to the Home Office, gave a lecture on Forensic Chemistry. The meeting was held jointly with the Hull Branch of the Pharmaceutical Society, and took place in the Central Police Station, Hull.

Dr Tryhorn commenced by illustrating the vast improvements which have taken place in methods of analysis over the last 20 years. With emission spectra analysis can be carried out with the minimum destruction of the sample, and with ultra-violet and infra-red absorption spectra non-destructive tests can be completed—a very important point where legal matters are involved. The use of chromatographic methods permits

previously impossible separations and identifications to be achieved. Other methods employed include the use of radioactive labelled compounds and electron microscopy.

The lecturer then surveyed the main fields in forensic chemistry, beginning with toxicology. Examples of how the chemist assists on toxicological matters were given. In many cases the methods of analysis used to detect and quantitatively measure poisons are the same basic methods as have been in operation for some years. By the use of refined techniques and equipment it is possible to obtain separations, in many cases at 90 per cent efficiency, and get the poisons in their original chemical form, whereas previously one only obtained degradation products. Biological methods of assay have sometimes to be used.

A second main branch of forensic work concerns the investigation of cases of driving under the influence of alcohol. The methods of determination of alcohol content in the body were described, and the quantitative limits to produce various degrees of intoxication were discussed.

The investigation of the causes of fires was an interesting and, in many cases, a very involved process. The mechanism of spontaneous combustion was described, and some examples of investigations which have been carried out were given.

Dr Tryhorn concluded by showing a series of extremely instructive slides illustrating points from the lecture. The lecture was most interesting and informative. Dr T. S. Harrison proposed the vote of thanks.

LEEDS AREA

A joint meeting of the Section with the Leeds University Chemical Society was held at the University on 25 October. Mr R. K. Fourness, Chairman of the Section, presided over a very large gathering, and Dr S. Dagley gave a lecture on 'The Chemistry of the Living Cell.'

The talk was based upon a series of general questions which might be put to a biochemist, and the extent to which they could be answered in the light of present knowledge. The first question chosen was: how does the chemistry of the living cell differ from that of other fields of study? The cell is a system in which, at 10–40°C, a multitude of chemical compounds are rapidly synthesized and degraded; their concentrations remain approximately constant because a balance is struck between the rates of synthetic and degradative reactions, and so a steady state is set up which demands a constant inflow of materials and energy. The existence of this complex chemical system depends chiefly on the enzymes that catalyse the reactions, and another fundamental question is, therefore, how, in terms of interactions between atoms or molecules, can enzyme catalysis be visualized? The complete answer to this question must await experiments that will reveal the architecture of enzyme molecules and the location of their active centres. Various methods are used to determine amino-acid sequences for proteins in general, and problems of secondary and tertiary structure are being tackled by X-ray analysis. A description of methods used to break down proteins leads naturally to the question how does the cell assemble amino acids to form a protein molecule containing one particular sequence out of millions of possibilities? This question links up with those relating to genetics, for the chemical compounds in the cell are in a constant state of flux; even structural elements are changing, atom for atom, with time, and yet the whole organism remains recognizably the same. Form and characteristics rather than materials and chemicals are constant, and in the final analysis this is due to the ability of the cell to reproduce, down to the last detail, enzyme molecules of unique structure that catalyse highly specific reactions. The relationship 'DNA makes RNA and RNA makes protein' was illustrated from bacterial transformations that are brought about by addition of deoxyribonucleic acid (DNA) to cultures and also from the work of Brachet and Gale with living cells, or preparations depleted of ribonucleic acid (RNA). By reference to its chemical structure, and particularly to the proposals of Watson and Crick, it can be shown that the molecule of DNA is one that may be pictured as functioning as a gene which could pass on 'information' to RNA, and so predetermine unique amino-acid sequences. The lecture ended with an outline of some of the findings of Zamecnik and his colleagues concerning 'transfer' and 'microsomal' RNA and their roles in connection with amino-acid 'activation' and incorporation into proteins.

After an interesting discussion a vote of thanks to the lecturer was proposed by Dr C. Earland on behalf of the Section, and seconded by Mr M. Spencer on behalf of the students' Society.

LIVERPOOL AND NORTH-WESTERN

Organization of the Analytical Laboratory. The opening meeting of the session was held on 6 October at the University of Liverpool. This was the occasion of the Chairman's Address, and Dr H. Bradbury introduced Mr E. Myer, deputy chief analyst of J. Bibby & Sons Ltd, who was Hon. Recorder of the Section for many years.

Mr Myer first paid tribute in a vote of thanks to Dr Bradbury, the retiring Chairman. The full title of his address was 'Some Reflections on the Design and Organization of Analytical Laboratories.' He began with a brief description of some aspects of the organization of his own and other laboratories, and some contrasts were drawn with research laboratories. The work of various specialized officers on the staff of large establishments was described. Comparisons were made

of the ratio of qualified chemists to assistant chemists to laboratory assistants; this showed analytical laboratories to be weighted with the last-mentioned grade.

A costing system was described and examples of the cost of some tests given. Some reflections were made on the consequences of costing. Amongst a medley of topics discussed was equipment for the mass performance of routine tests in batches and the 'streamlining' of methods of analysis. Mr Myer devoted some time to discussing the planning of new laboratories and the design of benches, and the useful 1959 B.S.I. booklet *Recommendations on Laboratory Furniture and Fittings* was mentioned.

The lecturer concluded with a brief survey of the trends in the analytical laboratory, culminating with some reference to the coming of automation.

Mr Myer did not exercise his prerogative as the new Chairman and dispense with questions, but instead invited a discussion, in which considerable interest was displayed. Dr Bradbury proposed the vote of thanks.

LONDON

Adhesion and Adhesives. On 5 October the lecture room of the Technological Research Station, Spillers Ltd, was filled by some 60 members and guests for the first meeting of the Cambridge Sub-Section. Dr J. Williams, the Chairman, introduced Dr N. A. de Bruyne, who spoke on 'Adhesion and Adhesives.'

The lecturer began by showing that the main problem of the theory of adhesion was to explain why adhesive forces in practice were not as strong as theory predicted. It could be calculated that London forces alone should lead to an attractive stress of about 68,000 lb/in^2 between metal plates separated by 4Å. These strengths were not achieved because of three main causes, namely, incomplete contact, residual stress, and uneven concentration of applied loads. In the first of a number of elegant experiments, Dr de Bruyne demonstrated how difficult it was to get even well-polished solids into intimate contact, as their surfaces were far from atomically smooth. Provided a solid could be deformed plastically without storing up elastic energy, and surfaces were clean, for example, free of oxide, it should stick well. This was demonstrated by cold-welding two pieces of scratch-cleaned aluminium strips.

The main function of an adhesive was to run into irregularities and improve the contact between the adherends. Normally, adhesives are liquids which can be solidified, or solids which by melting or the use of solvents are liquid at the time of adhesion. There were also 'pressure-sensitive' adhesives, always mobile and, while subject to creep, able to stick to almost anything since residual stress was avoided. Epoxy resins, with their low shrinkage on hardening, also produce relatively low residual stresses.

The lecturer then pointed out that when gluing it was important to use adhesives with good wetting power and if possible adherend surfaces which were wettable. Pressure-sensitive adhesives are not very good wetters; they rely on the fact that when any attempt to peel off a coated tape is made, a line of high compressive strength runs just ahead of the line of peeling. The surfaces of hydrophobic materials, such as polythene, could be made more wettable by chromic acid or flame treatment. Infra-red spectroscopy shows that carbonyl groups are so produced.

Dr de Bruyne finished his lecture by showing that despite the apparent difficulties in attaining the forces shown to be possible by theory, modern adhesives were strong enough to warrant their manufacture in large tonnages for structural purposes. A film was shown describing the superior strength and fatigue properties of bonded over riveted structures, and the lecture ended with the testing to destruction of duraluminium strips bonded with a polyvinylformal-phenolic resin adhesive (Redux). The metal failed at a load of 2,300 lb, the applied stress being 63,000 lb/in^2 at failure. A similar double-riveted joint failed at a load of 900 lb/in^2.

A lively discussion followed, involving such topics as the preparation of polyethylene for printing by electrical discharge, the possible use of wetting agents in adhesives, the phenomenon of light produced when adhesive bandages and tapes are unpeeled and the role of covalent linkages between adhesive and adherend.

A most interesting evening was reluctantly brought to a close by the vote of thanks proposed by Dr A. B. Adamson.

Synthetic Fibres. Mr P. A. Raine took the Chair at a meeting at Brighton Technical College on 11 October, when Dr C. A. Finch gave a lecture on synthetic fibres.

Dr Finch illustrated his lecture with a large selection of slides showing the characteristics of natural and synthetic fibres and various aspects of the manufacture of rayons. Interest in the subject was further enhanced by a display of fabrics based on synthetic fibres.

The three main natural fibres—wool, cotton, and silk—have been exploited by man for his own use for centuries. It is only in the last 75 years that he has succeeded in producing new fibres. These comprise regenerated fibres, in which polymers of natural origin are processed to yield fibres with useful properties, and truly synthetic fibres, the manufacture of which involves polymerization and processing.

Synthetic fibres based on cellulose are known as rayons. Various chemical methods exist for converting cellulose into a soluble form from which it can be regenerated in long threads or filaments. The earlier nitration and cuprammonium processes have little practical application today. The acetate process produces a useful rayon consisting of fibres of cellulose diacetate. The corresponding triacetate which possesses heat-setting properties is used with advantage in making pleated fabrics. The most important cellulose fibre,

however, is viscose rayon; its production exceeds that of all other man-made fibres, and is still increasing.

Three basic techniques are used to convert the soluble cellulose products into fibres. In wet 'spinning' the cellulose dope is extruded through extremely fine jets into a coagulating bath. The long filaments may then be chopped up and spun like cotton. Dry 'spinning' is employed when the solvent is very volatile (*e.g.* acetone); extrusion into a hot air blast causes rapid evaporation of solvent with consequent formation of a continuous filament of rayon. The third method, melt 'spinning,' is used primarily for nylon, terylene, polythene and so on. The polymer is melted in an atmosphere of nitrogen or carbon dioxide and extruded downwards.

In recent years we have seen the growth of fully synthetic fibres, such as the nylons, which are based on a repeating amide grouping, *e.g.* $-[CH_2]_4\cdot CO\cdot NH\cdot[CH_2]_6-$. Terylene is derived from terephthalic acid and ethylene glycol; the acrylic fibres, which yield fabrics such as Orlon, depend upon the copolymerization of acrylonitrile ($CH_2=CH\cdot CN$) with small amounts of other monomers.

The vote of thanks was proposed by Mr J. Hunt.

Some Chemical Aspects of Colour Photography. At a meeting at the South-East Essex Technical College on 20 October, Dr G. I. P. Levenson was the lecturer, the Chair being taken by Mr A. J. Turnbull.

Opening his lecture on a historical note, Dr Levenson referred to Clerk Maxwell's demonstration (1861) of the basic cause of perception of white light to consist of three stimuli—red, green and blue—and he then referred to the problems posed in colour photography and the variety of successful methods devised.

The basic problem is to record the red, green, and blue aspects from which the colour image is then produced by either an additive or a subtractive process. With additive systems, black and white silver images are used to modulate red, green, and blue light sources which together form a coloured image. In the subtractive process use is made of cyan-, magenta- and yellow-coloured images to filter the required colour from white light. From three-coloured records (red, green and blue), there are several ways of producing the final coloured image, *viz.* colour generation, colour destruction and colour transfer.

Colour transfer is achieved by successive transfer of the three subtractive dyes on to a suitable support, or by superimposition of coloured image layers. Colour destruction, although of less commercial importance, is achieved on azo dyes which are present with the finely-divided silver. Destruction is achieved in different ways, *e.g.* by hydrogen peroxide (Schintzel), hydrosulphate or stannous chloride (Christensen), bromic acid (Schweitzer) and acid thiourea (Gaspar). Colour generation relies on the conversion of the silver image to pigments or dyes.

Modern techniques rely mostly on conversion of the silver image to dyes. This is accomplished by a dye-forming development at the silver image, which is done either by solution-type couplers, or couplers incorporated into the photographic emulsion.

Black and white development:

silver bromide + developing agent → Ag + oxidized developer
↓
colourless waste products

Colour development:

silver bromide + developing agent → Ag + oxidized developer
+ coupler ↓ + coupler
↓ ↙
coloured dye image

Two ways of incorporating couplers in the emulsion are used; one relies on non-wandering systems (Agfa type), which include large hydrocarbon substituents in the emulsion to suppress diffusion in the gelatine, and the other uses couplers dispersed in water-permeable plastic micro-sacs or globules (Ektachrome type).

The lecturer then referred to defects in the colour image as due partly to unwanted absorption of light by dyes and particularly to absorption of blue by magenta and cyan dyes. By incorporation of yellow- and orange-coloured couplers in the magenta and cyan layers a corrective mask is formed by the couplers which are not converted to form a dye image, these masking techniques being used in some colour negative processes.

Concluding his lecture, Dr Levenson referred to the detailed problems of analytical chemical control of developers for both monochrome and colour in large-scale technical processing.

The lecture was very well illustrated by an excellent selection of slides; finally, a vote of thanks was proposed by Mr J. Ratcliffe.

Public Lecture. The Section's first Public Lecture was held on 26 October at Goldsmiths' College, New Cross. Mr P. A. Raine took the Chair and introduced Mr R. B. Collins of Ilford Ltd, who gave a lecture on 'Modern Colour Photographic Processes.' He gave a clear account, in popular terms, of the theory and practice of colour photography by the additive and subtractive processes, illustrating his talk with slides and demonstrations. He concluded by showing some examples, on colour transparencies, of the results which could be obtained. Mr W. H. Bennett proposed a vote of thanks.

Ilford Ltd and Kodak Ltd mounted displays of colour photographs for inspection before and after the lecture.

Film Show. A film show was held at Norwood Technical College on 8 November. The Principal, Mr H. V. Hillman, welcomed the audience and introduced the Chairman for the evening, Mr D. M. Freeland. The following films were shown: 'Armourplate' and 'Armourlight' Glass, Discovery of a New Pigment and

the Griseofulvin Story. At the conclusion of the evening, Mr M. A. Fill, head of the chemistry department, proposed a vote of thanks to the London Section for providing the film show, and the Chairman expressed the appreciation of the audience to the College authorities for the facilities provided.

Some Aspects of Chemotherapy. On 10 November, Dr H. J. Barber, research controller, May & Baker Ltd, again gave a lecture on this subject at Croydon Technical College. The Chair was taken by Mr P. A. Raine. The content of this lecture has already been reported (*see J.*, 224).

After questions and discussion, a vote of thanks was proposed by Dr Erica Glynn, and the Chairman expressed the thanks of the meeting to the Governors of the College and to Dr S. R. Robinson, head of the science department, for their co-operation.

MANCHESTER AND DISTRICT

On 13 October, Dr A. E. Werner, Keeper of the British Museum Research Laboratory, gave a lecture on 'The Scientific Examination of Paintings and Antiquities' at Bolton; more than 100 people attended. The Chair was taken by Dr S. J. Fletcher, Vice-Chairman of the Section, who, after saying a few words about the Section, introduced and welcomed Dr Werner.

Dr Werner's lecture contained interesting and varied chemistry and a wide fund of information on paintings and antiquities. He first dealt with the examination of paintings, illustrating the structure of a painting, and then describing in detail the various methods of examination, such as the use of X-rays. Certain pigments can be identified because their mass absorption coefficients vary. Infra-red photography can penetrate layers of certain paints and show alterations, renovations and so on; the use of ultra-violet fluorescence and photography was also discussed. He then turned to general chemical techniques for identifying paints and other materials, and showed how paint fragments were mounted and examined; the use of paper chromatography was illustrated.

Dr Werner then mentioned methods of overcoming certain difficulties when dealing with antiquities. Wooden objects which had been standing in moist soil for many years became saturated with water and swollen, and metals had to have corrosion removed. He also gave instances where metallographic and X-ray examination had to be carried out before restoration could take place; certain alloys had to be annealed before objects could be restored and repaired. The question of authenticity of antiquities and paintings was also discussed.

The lecture was illustrated with excellently reproduced slides, in black and white and in colour. A vote of thanks was proposed by Mr A. J. Jenkinson, Principal of Bolton Technical College.

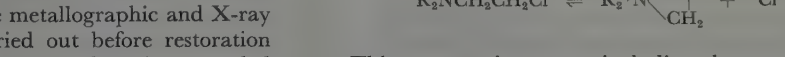
MID-SOUTHERN COUNTIES

Observations on Analytical Chemistry. A joint meeting with the Western Section of the Society for Analytical Chemistry was held on 21 October at the Red Lion Hotel, Salisbury. Dr J. Haslam of Imperial Chemical Industries Ltd, Plastics Division, gave a lecture entitled 'Some Observations on Analytical Chemistry.' He reviewed his early work on potentiometric titrimetry, which helped eventually in the building of an automatic titrimeter. The early work of Sand was particularly mentioned, and titrations using older forms of manual potentiometer were described. Examples were given of the use of instruments for titrations to pre-set end points; these included EDTA titrations and the determination of chlorine in polymers. Apparatus for full-scale titrimetry was described. An electrically-fired oxygen combustion flask was demonstrated, and observations were made on the determination of boron, phosphorus, mercury, iodine and so on, with this apparatus. Many of the new colorimetric methods for determination of fluorides, phosphates, nitrites, sulphates and mercaptans were discussed.

In conclusion, some of the principles of gas–liquid chromatography were outlined, and examples given of the application of the procedure in the plastics industry. Dr Haslam illustrated his lecture with many slides and demonstrations. After questions, the meeting closed with a vote of thanks proposed by Mr S. L. Kidman.

Adrenaline Antagonists. A joint meeting with the Southampton University Chemical Society and the Chemical Society was held on 4 November at the University, Southampton. Professor N. B. Chapman, of the University of Hull, gave a lecture entitled 'The Chemistry and Pharmacology of some Adrenaline Antagonists.'

Professor Chapman began with a short description of the nervous system and the role of the sympathomimetic amines in the autonomic system. He divided the adrenaline antagonists into five classes, and after a brief discussion passed quickly on to consider the halogenoalkylamines, biological alkylating agents of the type $R_2N{\cdot}CH_2{\cdot}CH_2X,HX$. He proceeded to show that their mode of action depends upon ring closure.



This tautomeric system, including the mechanism of the transformation and 'kinetic pharmacology,' was discussed in great detail.

Professor Chapman concluded by giving the detailed preparation of some of the compounds and the effect of substituents; he considered future work, especially on the chemistry of receptors. The lecture was illustrated by many slides.

The audience was warmly appreciative of Professor Chapman's presentation and many questions were asked, giving rise to lucid answers. The vote of thanks was proposed by Dr R. E. Parker.

Bacterial Corrosion. On 24 October a meeting was held jointly with the Portsmouth and District Chemical Society, the Portsmouth and District Physical Society and the Chemical Society at the Portsmouth College of Technology. Dr G. H. Booth of the National Chemical Laboratory spoke on 'Bacterial Corrosion.'

Dr Booth began with a brief explanation of corrosion in general. Corrosion may, however, take place in waterlogged clay where air, normally essential, is excluded. Under such circumstances the role of the air is taken over by bacteria.

The audience was then introduced to the principal bacteria concerned, *Desulphovibrio desulphuricans* and *Desulphovibrio orientis*, both being obligate anaerobes of almost universal distribution. The latter requires organic material for growth but the former can grow in autotrophic conditions. The speaker went on to talk of the theoreies of bacterial corrosion put forward by von Wolzogen Kühr and by Starkey, and discussed the work being done at the National Chemical Laboratory in relation to these two theories. It has been shown that *D. orientis* corroded metal by virtue of its sulphide production only, but that *D. desulphuricans* may, because of enzymic difference, also cause cathodic depolarization as it will utilize the hydrogen at the cathodic areas of the metal surface.

Dr Booth then spoke briefly on the Thiobacilli, an aerobic group of bacteria, and other bacteria which allow the corrosion of concrete, cellulose and plastics to proceed.

Protective methods include the use of quaternary ammonium salts as bacteriacids, the application of a negative potential to the metal to eliminate anodic spots and the complete exclusion of bacteria by encasing the metal in some impervious material. Frequently none of these is practicable.

Dr Booth answered a variety of questions, and the meeting was closed by a vote of thanks proposed by Mr D. H. Bell.

NORTH LANCASHIRE

Infra-red Spectroscopy. On 21 October Dr L. J. Bellamy gave the joint Section and Glaxo Laboratories Scientific Society Lecture at Ulverston. He covered some of the varied uses of infra-red spectroscopy in the solution of chemical problems. Classically, the method is associated with the evaluation of molecular constants from measurements of the rotational fine structure of small molecules. However, alongside this the empirical 'group frequency' approach has been widely developed for the study of structural features in larger molecules. So many data are available in this second field that we can now begin to rationalize them, at least for the more useful group frequencies. It can be shown that frequency shifts of XH and of multiple bonds depend primarily upon the impact of inductive and resonance effects, and that these vary with the nature of the substituents and the geometric arrangement. This concept is supported by the many relationships which have been established between frequency shifts and kinetic data, and also by the prediction of abnormal frequencies in specially designed molecules.

However, there are many other valuable applications which do not depend directly upon the group-frequency concept. Stereochemical studies such as those of Kuhn or Horak on large rings enable us to study the geometry of these compounds in a simple and elegant way. The stereochemistry of hindered phenols can be studied in a similar way. There are also important and useful applications in studies of hydrogen bonding, of rotational isomerism and in the chemistry of bacteria.

Dr Wilkins proposed the vote of thanks.

Inaugural Dinner and Address. The Section Inaugural Dinner and Lecture was held in the Catering College, Blackpool, by courtesy of the Principal, Mr E. Shepherd, on 29 September. The dinner was cooked and served by students and reflected the very high standard maintained by the College.

The Dinner was followed by a lecture given by Dr Magnus Pyke. His subject was the changes in outlook in food chemistry during a life-time—he hastened to add the word 'unfinished.' This was an informative lecture tinged with wit.

He dealt with the elementary processes taking place in the human engine, and explained how carbohydrates are used under conditions of controlled combustion. This process is upset when deficiency of vitamin B arises, thereby causing an accumulation of pyruvic acid in the body. A slide depicted the onset of polyneuritis in the pigeon due to feeding a diet of polished rice. Another slide illustrated the remarkable cure brought about by giving a dose of a vitamin B complex, which quickly corrected the opisthotonos (retraction of the head). The vitamin B deficiency disease known as beri-beri is still found in some parts of the world, in spite of the fact that the cure has been known for 25 years. Dr Pyke was quick to add that 'beri-beri is seldom seen now in this country.' The vitamin era has passed—we now take them for granted—but for political and economic reasons these deficiency diseases still appear in various parts of the world.

With the aid of charts he demonstrated that children have tended to grow more rapidly during the last few years, but on the experimental evidence derived from the feeding of animals a rapid growth at an early age does not imply a greater span of life. Indeed, the lavish feeding of children may be disadvantageous. A gradual build-up to maturity is better suited to the human body.

Dr Pyke then referred to the incidence of coronary heart disease, which is becoming prevalent in this country. The cause of this disease is not known exactly, but an intake of an excess of fatty foods leads to a deposition of cholesterol, which clogs the arteries near to the heart.

The advent of fat extenders, artificial food colours, antioxidants and so on had made food more acceptable, but the presence of these additives could lead to complications and impair the working of the human engine. The question at issue was, should these risks be tolerated? Such were the problems presented to the scientist interested in nutrition. Throughout his lecture, Dr Pyke stressed the interesting problems that still exist in the fields of nutrition and food chemistry. Some of these problems had been solved during his lifetime, but many others are still a challenge to the chemist.

Mr C. D. Lafferty proposed a vote of thanks to the lecturer for one of the most interesting and stimulating lectures that had been given to members of the Section.

North Wales

A meeting was held at the Flintshire Technical College, Connah's Quay, on 19 October. The Chairman of the Section, Mr F. Holmes, introduced Dr W. H. Wilson, of Imperial Chemical Industries Ltd, Widnes, who gave a lecture on 'Fluorine—the taming of an element.'

Dr Wilson outlined highlights in the development of cells for making fluorine from the time of Moissan to the present day, and indicated difficulties encountered. He gave reasons for the present-day exclusive use of medium-temperature cells operating at 80°C–110°C and employing KF.2HF as electrolyte. One of the greatest problems in the development of fluorine cells has been to find a suitable anode material. Platinum anodes, as used by Moissan, are severely corroded, as are those of other metals such as nickel. Graphite disintegrates when HF : KF $> 1{\cdot}8 : 1$. Carbon anodes are now normally employed, but in some modern cells anode polarization is still a recurrent phenomenon. By using a suitable form of high-permeability amorphous carbon, anodes can be obtained that do not disintegrate or wear and are entirely free from polarization.

Electrolytes at medium temperature do not wet carbon anodes (contact angle about 150°C), and this gives rise to peculiarities in the way in which fluorine is liberated at these anodes. Normally no bubbles of fluorine leave the anode surface; all the gas is evolved at the interface of the electrode, electrolyte and gas space. When a porous carbon anode with a copper tube pressed into it is submerged so that only the copper tube breaks the electrolyte surface, all the fluorine is evolved via the tube.

Using a simple form of cell based on the above, the lecturer prepared fluorine and illustrated many of its properties. In addition, the properties of ClF_3, which are very similar to those of fluorine, were also demonstrated. Such experiments transformed fluorine and interhalogen compounds from textbook chemicals into chemicals which can be handled in a laboratory. Methods of handling fluorine on the laboratory and plant scale were described. Almost all metals are satisfactory construction materials at room temperature; nickel is supreme at high temperatures. Glass can be used up to 200°C, provided hydrogen fluoride is absent. Hydrogen fluoride can be removed by absorption in sodium fluoride or by refrigeration. Elementary fluorine is made on a large scale for the production of chlorine trifluoride and uranium hexafluoride. It also makes possible the preparation of lubricants—fluorocarbons and chlorofluorocarbons—with high chemical resistivity. The application of these compounds is illustrated by their use as refrigerants, aerosols and anaesthetics.

The excellent lecture inspired lively questions; a vote of thanks was proposed by Dr C. G. Lyons.

Sheffield, South Yorkshire and North Midlands

Direct Reduction of Iron Ore. The first meeting of the 1960–61 programme was held jointly with the Sheffield Metallurgical Association on 1 November. A lecture on 'Direct Reduction of Iron Ore and its Future in Steelmaking' was given by Mr J. Mackenzie, of the United Steel Companies Ltd, research and development department.

Mr Mackenzie dealt first with the basic chemistry of direct reduction processes, and discussed the conditions of equilibria and kinetics appropriate to the use of carbon monoxide or hydrogen as the reducing gas. Carbon monoxide was theoretically superior below about 800°C, provided dissociation could be avoided, but hydrogen was to be preferred at higher temperatures. From the point of view of rate of reaction, the higher temperatures were desirable, but it was necessary to avoid sintering in the product and consequent loss of reactivity. On the other hand, operation at lower temperatures might lead to difficulties in handling a pyrophoric iron powder.

Mr Mackenzie said that for large-scale steelmaking, it was unlikely that any direct reduction process was capable of competing with a modern blast furnace installation, but where an output on a smaller scale was desirable, or where suitable coke was not available, then direct reduction might have real advantages. This was particularly true of industrially undeveloped areas. He went on to say that in Britain a considerable expansion of electric steelmaking was planned, and direct-reduced iron offered a means of satisfying the extra demand for virgin iron units which these installations would create. In wider context, Mr Mackenzie suggested that since Britain was a net importer of both iron ore and fuel there may be something to be said for direct reduction overseas where ore and fuel are at minimum cost, and transporting iron rather than iron oxide to Britain.

The Chair was taken by Dr A. S. C. Lawrence, for the Institute, and after the discussion the vote of thanks was proposed by Mr W. C. Heselwood, President of the Metallurgical Association.

TEES-SIDE

Epoxide Reactions. On 28 October, at Norton-on-Tees, Dr R. E. Parker addressed a joint meeting with local members of the Chemical Society and the Society of Chemical Industry on the 'Mechanism of Epoxide Reactions.'

Dr Parker described the many products that epoxides give in polymerization reactors which find wide application in paints, as constructional materials and as non-ionic detergents. Epoxides are also important synthetic reagents for the preparation of alcohols and substituted alcohols (*e.g.* amino-alcohols). These uses are increasing and, because of the high reactivity of epoxides and the ease of their preparation from olefins, are likely to increase even further. Since almost all reactions of epoxides involve opening of the three-membered ring by nucleophilic attack at one or other of the ring-carbon atoms, it is of interest to make fundamental studies of the mechanisms of these reactions. A study of the mechanism is being carried out by combined kinetic studies and product-ratio measurements on the reactions of various nucleophiles with monosubstituted ethylene oxides in solution. The results permit the rate of reaction at each position of the epoxide ring to be calculated, and each of these rates has been correlated with the effect of (*a*) substituents, (*b*) solvent and (*c*) acid catalysis.

The effect of substituents (in *m*- and *p*-substituted tyrene oxides) is unusual in that a given substituent increases the rate at one position but decreases it at the other. Acid catalysis increases the rate at both positions, but to different extents. Changing the solvent also has a differential effect on the two rates, but its outstanding effect is to bring about a great decrease in rate on changing from a hydroxylic to a non-hydroxylic solvent, even though the two solvents have high dielectric constants.

EASTERN INDIA

Annual General Meeting. The A.G.M. of the Section was held on 29 June at the School of Tropical Medicine, Calcutta, with Dr N. K. Sen in the Chair. The report of the Hon. Secretary and the audited statement of accounts for the year 1959–60 were adopted. The following were elected officers and members of committee for the ensuing year: Chairman, Professor N. K Sen; Vice-Chairmen, Professor R. B. K. N. Bagchi and Mr N. Sen; Hon. Secretary, Dr A. B. Sen Gupta; Hon. Treasurer, Professor R. N. Chakravarti; Members of Committee, Drs H. K. Banerjee, D. B. Das, S. C. Ray, N. C. Sen Gupta, P. N. Sen Gupta, J. W. Whitaker, and Mr S. N. Mitra. Messrs Pal & Roy, Chartered Accountants, Calcutta, were re-elected Hon. Auditors.

After the formal business, the Chairman gave an interesting talk on 'Science in the Detection of Crime.' It was pointed out that the problem of detection of crime was vitally concerned with the very roots of the social life of civilized people of all countries. Even the primitive tribes employed certain irrational and arbitrary procedures for ascertaining the guilt of an accused person, but the methods based on systematic scientific observation as followed now are of comparatively recent origin.

In discussing the history of the development of the scientific methods for detecting crime, as well as the growth of forensic science laboratories, Professor Sen mentioned that originally the services of a person specializing in medico-legal science were always called for in crime detection. After the First World War certain Western countries, particularly Great Britain, realized the importance of setting up within the framework of the police organization small laboratories which would work in close co-operation with the local universities and technical colleges to help in detective operations. A number of Regional Forensic Science Laboratories covering the whole of Britain were established in 1933. In India, the first laboratory of this nature was set up in Calcutta by the Government of West Bengal in 1952, and the second, initiated by the Government of India, was established in 1957, also in Calcutta; recently similar laboratories have been set up both in Bombay and Madras.

Professor Sen described the organization of the Forensic Science Laboratory, which consists of four main sections, chemistry, physics, biology and ballastics, with such sub-sections as foot-prints, questioned documents and photography. After giving a rough idea of the type of work with which the members of the individual sections were generally entrusted, he stressed the importance of original research in dealing with certain difficult cases, and finally gave a selection of interesting cases of detection of crime based predominantly on scientific investigation in which the laboratory took an important part.

A lively discussion took place after the talk, and the meeting was terminated by a vote of thanks proposed by Professor R. N. Chakravarti.

MADRAS

Members of the Section visited the factory of Addisons Paints & Chemicals Ltd, Huzur Gardens, on 20 March. The party was shown round the factory by the manager, who took considerable pains to explain the various special features. Afterwards they were entertained to tea by the management.

A scientific meeting of the Section was held on 14 April at the chemistry department of the Presidency College, when Professor S. Rangaswami gave a lecture on the chemistry of *Thevetia Neriifolia*. There was a good attendance for this entertaining lecture.

News and Notes

AWARDS AND COURSES

Beit Fellowships for Scientific Research.—Normally one Fellowship of annual value £600, in addition to college fees, will be awarded each year. The tenure of a Fellowship will be for two years, subject to a favourable report by the supervising professor. Men and women candidates, of European descent by both parents, must be under 25 and hold a degree of a university in the British Commonwealth or a diploma or associateship of an approved college. The holding of any other scholarship or fellowship disqualifies.

Applicants must give full information as to qualifications, academic standing and previous career, and state the general character of the research it is proposed to carry out, and the names of not more than three referees, one of whom shall be a teacher of the college or university at which the candidate took his or her examination. No testimonials should be sent.

Application forms may be obtained from the Registrar, Imperial College, Prince Consort Road, London, S.W.7, and must be returned not later than 1 February, 1961.

Royal Military College of Science.—Every year a number of scholarships at the Royal Military College of Science, Shrivenham, are offered to civilian students. Successful candidates take courses, normally of three years, for the degree of B.Sc. (Special) in chemistry, physics or mathematics or B.Sc. (Engineering) of the University of London. The courses are specially designed to train young scientists for Government Research Establishments, and boys to whom awards are made are expected to join the Scientific Civil Service when they have taken their degrees.

A Scholarship carries exemption from payment of tuition and examination fees and the student receives a maintenance allowance of £355 a year. No means test is imposed and the allowances are not liable to income tax.

Candidates must be under 22 years of age on 1 October of the year of entry, unless they have completed their National Service, when they must be under 24, and must satisfy the conditions of the University of London for registration for the B.Sc. degree course.

The academic standard at present required to qualify for an award lies somewhere between that for a University Scholarship and for a County Award.

Application forms and further information about the scheme may be obtained from the War Office, C.13(c)3, Room 338, The Adelphi, John Adam Street, London, W.C.2.

New Course in Chemical Engineering.—Undergraduate students will be accepted from the session 1961–62 onwards in the Department of Chemical Engineering of the University of Nottingham. The course will last for four years and lead to the Honours B.Sc. Degree. Full particulars will appear in the Prospectus for 1961-62.

MEETINGS AND CONFERENCES

British Society of Rheology.—A meeting on Theoretical Rheology will be held at Reading on 20–21 April, 1961. It is intended that speakers should emphasize the physical aspects of their work rather than the mathematics only, since it is expected that a wide range of interests will be represented amongst those attending the meeting. Further information may be obtained from Dr M. F. Culpin, 8 The Broadway, Pontypool, Mon.

Interaction between Fluids and Particles.—The first part of the Third Congress of the European Federation of Chemical Engineering will be held in London on 20-26 June, 1962, on the occasion of the Chemical and Petroleum Engineering Exhibition at Olympia. The major event in the programme is a three-day meeting organized by the Institution of Chemical Engineers on 'Interaction between Fluids and Particles.' This meeting will be one of the most important international events on this subject which have taken place for many years. Suggestions for papers for inclusion in the programme are invited, and should be sent to the general secretary of the Institution, 16 Belgrave Square, London, S.W.1.

Iron and Steel Institute.—The Special Meeting in the U.S.A. and Canada of the Iron and Steel Institute will be held in October and November, 1961. The provisional programme provides for an official welcome in New York City, and visits to important laboratories and works in the United States and Canada. Members have been invited to attend the National Metal Congress in Detroit and to be guests at the annual banquet of the American Society of Metals on 26 October, 1961. Full information will be available in the spring of 1961 from the Secretary, Grosvenor Gardens, London, S.W.1.

New Developments in Plastics.—A symposium on this subject will be held on 11 February, 1961, at the Bradford Institute of Technology. It has been arranged by the Bradford Chemical Society, the Yorkshire Section of the Plastics Institute and the department of chemical technology of the Bradford Institute of Technology, in conjunction with the Yorkshire Council for Further Education. There will be four lectures and time for questions and discussion following each lecture. Further details may be obtained from Dr R. P. Sheldon, Department of Chemical Technology, Bradford Institute of Technology, Great Horton Road, Bradford, 7.

Physics of Polymers.—The Institute of Physics and the Physical Society is arranging a conference on the 'Physics of Polymers,' to be held at the University of Bristol on 10-12 January, 1961. Topics for the

principal sessions are statistics of chain configurations, molecular motions in polymers, fibre structures and crystallinity in polymers, and irradiation effects. It is hoped that Professor Hermann Mark will give the main introductory lecture, and Sir Gordon Sutherland an evening lecture on infra-red spectroscopy of polymers. Further information and preliminary programmes may be obtained from the Secretary at 47 Belgrave Square, London, S.W.1.

Polarography in the Food Industry.—A one-day Symposium has been organized by the Polarographic Society on 'The Applications of Polarography in the Food Industry.' The meeting will be held at the South-East Essex Technical College, Longbridge Road, Dagenham, on 5 January, 1961, beginning at 11 a.m. Papers will be read in the morning and afternoon, and the proceedings will be completed by a showing of the film on Polarography in the evening. Lunch and tea are available at the College. All inquiries should be addressed to Mr K. Baker, department of chemistry and biology, South-East Essex Technical College.

RECENT PUBLICATIONS

Fortschritte der Destilliertechnik.—Volume 37 of the Dechema Monographs, *Fortschritte der Destilliertechnik* (Progress in Distillation Engineering) contains an account of three comprehensive experimental investigations on rectifying columns, with numerous illustrations and tables. It is published by Verlag Chemie GmbH., Weinheim/Bergstrasse, price DM 21.25.

Historic Books on Mining.—The Science Museum has arranged a special exhibition of books on mining and kindred subjects in co-operation with the Institution of Mining and Metallurgy. The 62 items form part of the collection of Mr Robert Annan who has provided an introduction to the catalogue, obtainable from the Science Museum, price 1*s.* 6*d.* net.

Pure and Applied Chemistry.—The journal *Pure and Applied Chemistry*, the official journal of I.U.P.A.C. (London: Butterworths Scientific Publications, £6 per four-part volume), has been founded to collect in one publication the many reports and papers which are prepared by the commissions, sections and divisions of I.U.P.A.C. It will also contain reports of meetings and symposia held under the aegis of that body. The bulk of the first issue is in fact devoted to papers presented at a symposium on activation analysis, which was held in Vienna in 1959. A full report on the discussion is also given. The other reports are more indicative of the type of subject on which international agreement is being secured by the Union. They include, for example, recommendations on test substances for the microdetermination of carbon and hydrogen and on nomenclature and the presentation of data in gas chromatography, as well as a report on the calibration of wavelength and photometric scales for non-recording spectrophotometers. The activities of the Union are such that we may look forward to a continuing stream of similar reports on topics in pure and applied chemistry and their publication in this form is certain to be of value to a wide circle of readers. H. J. EMELÉUS

United Kingdom Postgraduate Awards.—The Association of Universities of the British Commonwealth has recently published the tenth edition of *United Kingdom Postgraduate Awards*. This booklet sets out, in a form suitable for quick reference, summarized information on fellowships, scholarships, grants and so on that are available at universities in the United Kingdom. A short list of awards tenable outside the United Kingdom by U.K. graduates is appended. The Association is making the publication available to universities and libraries, and to other institutions on request (36 Gordon Square, London, W.C.1).

An Introduction to Ion Exchange.—This is the title of a new 16 mm instructional film in sound and colour. It is the first film on ion exchange to be made in this country and has been produced by the Permutit Co. Ltd, Gunnersbury Avenue, London, W.4. The film, which will be available on free loan from 1 January, 1961, gives a scientific introduction to the subject and will be of interest to students, research workers and potential users of ion exchange. It runs for 27 minutes. Bookings may be made on application to the Permutit Co. Ltd.

Members are reminded that the first filmstrip in the new R.I.C. series, published by Common Ground Ltd, is *Ion Exchange Resins* by Dr T. V. Arden, *Fellow*, of the Permutit Co. Ltd, and Dr J. E. Salmon, *Fellow*, of the Battersea College of Technology. Copies of the filmstrip, complete with teaching notes, may be obtained from the Educational Supply Association, Pinnacles, Harlow, Essex (price 42*s.* each).

Drug Research and Development.—The latest annual survey carried out by the Association of British Pharmaceutical Industry discloses that £6,257,025 was spent on research into and the development of new and improved drugs by members of the Association last year—an increase of more than a million pounds on 1958 and double the amount spent in 1954. The research establishments carrying out this work employed 1,374 graduates and 2,664 other staff. In addition, £273,013 was donated to independent research organizations.

Terylene Plant in Northern Ireland.—Imperial Chemical Industries Ltd have completed the purchase of some 200 acres of land at Kilroot, near Carrickfergus, County Antrim, as a site for a factory for the manufacture of Terylene and possibly other fibres, for example polypropylene fibre. Site development at Kilroot will begin early in 1961 with a view to starting production in 1963

Correspondence

LABORATORY RISKS AND SAFEGUARDS

Opening of Sealed Ampoules

SIR,—It seems desirable that information should be made known generally about two accidents involving dimethylamine which have happened here during the present year. The dimethylamine is obtained in sealed, soda-glass ampoules containing 100 g. Dimethylamine boils at 7°C under atmospheric pressure and at 20°C its vapour pressure is 1·7 atm. Last February a research worker was immersing an ampoule in an acetone–'Drikold' mixture in preparation for opening it when it exploded. One eye was injured and he is still without sight in it. As a result of this accident, precautions for personal security were made much more stringent. In June a similar explosion occurred. The temperature of the cooling bath had been measured (—20°C). The operator was well protected and there was no personal injury. The ampoule exploded as soon as it touched the cooling mixture. Some parts of the ampoule were recovered afterwards and it was found that the glass was very uneven in thickness. At its thickest point, the bottom, the glass was 9 mm. thick. Near the top it was less than 1 mm. thick (see photograph). We have pressed the suppliers to provide

dimethylamine in Pyrex ampoules but they state it is impossible to do this, and that they have had no adverse reports from other laboratories on soda-glass ampoules.

It is clear that the opening of such ampoules must be approached as a potentially dangerous operation. I should be very grateful to hear from any other worker who has had a similar experience with an ampoule in which a chemical is stored under pressure and which needs cooling before opening. If evidence is forthcoming that such accidents have happened elsewhere it will strengthen the case against the use of soda-glass for the construction of these ampoules.

A. F. H. WARD,
Departmental Safety Officer and Senior Lecturer in Physical Chemistry
Department of Chemistry
Manchester College of Science and Technology,
Manchester, 1

Nitrobenzene and Nitric Acid

We learn from the Tennessee Eastman Co. that it is believed that the explosion which occurred at its Kingsport plant recently was the detonation of a mixture of nitrobenzene, nitric acid and water. It has been concluded that a substantial concentration of water was present at the time of the explosion. The violence of the explosion indicated that the mixture was detonated with a speed and power comparable to TNT. This experience gives warning of the great potential dangers associated with a mixture of nitrobenzene and nitric acid even with substantial quantities of water present.

(Comments from readers would be welcomed.—ED.)

How Does the Periodic Table Begin?

SIR,—I should like to challenge the suggestion made by your correspondent in last month's *Journal* that hydrogen should rightfully be classified with the halogens, rather than with alkali metals.

Surely the criterion of classification should be: does hydrogen resemble the group IA metals by tending to donate its valence electron to produce a cation, or does it on the other hand resemble the halogens by acquiring an additional electron to produce an anion? Although pure compounds of hydrogen are covalent, it is well known that many furnish a proton in water, the only exception to this being the salt-like hydrides.

Professor Guggenheim's argument would surely have been more accurate had he compared RH with RLi and RF. Such a comparison shows that the difference between RH and RLi, where R is an organic radical such as CH_3, is by no means so marked as the difference between RH and RNa.

Admittedly, hydrogen shows some analogies with the halogens; and there is to my mind some virtue in the more recent tendency to classify the element as belonging to both groups I and VII. However, I would suggest that both qualitative and quantitative considerations show that there is rather more justification in classifying hydrogen with group IA than with any other group.

G. BUTTERS
Student Member
46 Morecambe Road,
Lancaster

Obituary

Gordon Lemuel Coles. *B.* 18.6.02. *Ed.* Stationers' Company's School; Royal College of Science, London, 1922–25. B.Sc. He became an assistant in the research laboratory of Boots Pure Drug Co. in 1919, where he remained until 1922. On completion of his training in 1925, he joined Shell-Mex & B.P. Ltd, and later became assistant chief chemist. At the time of his death he held a post in the oil products development department of the Shell Petroleum Co. Ltd. (*A.* 1925.) *D.* 13.9.60.

Robert Crosbie Farmer. *B.* 30.11.1877. *Ed.* University College, Liverpool, 1894-97; B.Sc. Research at Würzburg, under Professor Hantzsch, 1897-99; Ph.D. Awarded a Priestley Scholarship, University of Birmingham, in 1900, and worked under Professor P. F. Frankland, becoming a lecturer and demonstrator there. M.Sc. (Birm.), D.Sc. (Liv.). In 1902 he was appointed assistant superintendent of the newly-formed Explosives Research Department at Woolwich. In 1914 he was transferred to the Department of Explosives Supply, becoming chemical adviser to the Director-General (Lord Moulton) and Head of the Chemical Section. Member of the Munitions Inventions Committee, Nitrogen Products Committee, and other Committees, and acted as representative of Lord Moulton at the Ordnance Committee. Appointed O.B.E. in 1918 and also received the Cross of St Anne (a Russian decoration). After the war he became technical director, W. J. Bush & Co. Ltd, but in 1922 he returned to the Research Department, Woolwich, at the request of the Government, and remained there until his retirement in 1945. As Deputy Director of Explosives Research, he was closely concerned with new developments in explosives and with drawing up research programmes. After his retirement, he undertook private research at King's College, London, for some years, and published three papers in 1959, when he was 81. His recreation was walking, which he enjoyed almost to the end of his life. His complete integrity, high principles and generosity were remarkable. He always retained his interest in, and affection for, the town of Würzburg, which he frequently visited. He had abundant wit and was fond of good music, the countryside and cats. (*F.* 1916, Council 1923-24). *D.* 30.7.60.

Harold Lowe. *B.* 1887. *Ed.* The King's School, Chester; University of Manchester, 1906–09. B.Sc., M.Sc. He became chief assistant to his father, Mr W. F. Lowe, public analyst and assayer, in 1911, and later became deputy public analyst for a number of counties. He succeeded his father in 1930, and remained in control of the practice for the rest of his life. At the time of his death he was public analyst for the counties of Anglesey, Caernarvon, Denbigh, Flint, Merioneth, Montgomery and Shropshire, the City of Chester, and the Boroughs of Shrewsbury and Wenlock. He was also consulting chemist and bacteriologist to the Chester Waterworks Co., Conway and Colwyn Bay Joint Water Supply Board and Flint Corporation Waterworks. 'Harold Lowe did not seek the limelight and was content to attend to his business and to seek his relaxation in boating and fishing.' (*A.* 1911, *F.* 1914.) *D.* 23.7.60.

Norman Picton. *B.* 2.11.1884. *Ed.* Aberdare Grammar School; University College of Wales, Aberystwyth, 1901–06; University of Leipzig, 1906–08. B.Sc.(Wales), Ph.D.(Leipzig). He became a chemist with C. W. Martin & Sons Ltd in 1908 and joined Nobel's Explosives Co. Ltd, Ardeer (now Imperial Chemical Industries Ltd, Nobel Division) in 1911. He remained there until his retirement in 1946, when he was deputy research manager. His chief interests were local history, languages, music, literature and horticulture. He was vice-president of the North Ayrshire Liberal Association. 'None who knew Dr Picton failed to recognize his sense of humour and, above all, his sympathetic understanding of other people's problems.' (*F.* 1917.) *D.* 28.7.60.

Bawa Kartar Singh. *B.* 17.4.1886. *Ed.* University of Cambridge, 1904–10. M.A., Sc.D. He returned to India in 1910 and was appointed professor of chemistry at Dacca College. He took a similar post at the Government College, Lahore, in 1918, where he remained until 1921, when he was transferred firstly to Patna College, and later the same year to Ravenshaw College, Cuttack. Sc.D. (Dubl.), 1921. He returned to Patna College in 1926, but left in 1940 on his appointment as professor of chemistry at the University of Allahabad, where he was granted the title of Emeritus Professor of Chemistry in 1947. He became honorary professor of organic chemistry at Panjab University Institute of Chemistry, Lahore, in 1947, but left the following year as the result of political complications, and became honorary research professor of chemistry at Benares Hindu University in 1948. He retired finally in 1960. He was the author of a number of scientific papers. (*F.* 1921.) *D.* 16.6.60.

Conrad Gallimore Wenyon. *B.* 6.10.1891. *Ed.* Dundee High School; University of St Andrews, 1910–14. M.A., B.Sc. He joined the New Explosives Co. Ltd, Stowmarket, as a works control chemist in 1915, and three years later was appointed to a similar post in the British Dyestuffs Corporation Ltd (now Imperial Chemical Industries Ltd). He was promoted to departmental manager in 1930, a position that he held until his retirement in 1953. (*A.* 1921.) *D.* 20.9.60.

THE REGISTER

NEW FELLOWS

(P) CHEESEMAN, Gordon William Henry, B.SC., PH.D.(LOND.), D.I.C., A.R.C.S.
(U) HECKSCHER, Rudolf, D.PHIL.(MUNICH).
(J) SAWYER, Montagu Frederick, B.SC.(LOND.), PH.D.(BIRM.), M.I.CHEM.E.
(P) WILLIAMS, Gareth Howel, B.SC., PH.D.(LOND.)

ASSOCIATES ELECTED TO THE FELLOWSHIP

(Y) ALLEN, Keith William, B.SC.(R'DG), M.SC.(LOND.)
(C) BEIGHTON, James, B.SC.(LOND.), A.M.I.CHEM.E., M.INST.F.
(Q) BROWN, John, A.R.T.C.S.
(P) CALVETE, Louis Gerald, B.SC.(LOND.)
(Y) CLARKE, James Harle
(F) CONATY, Francis Nicholas Gerrard, B.SC.(DUBL.)
(P) COSKIE, Ronald, A.M.I.CHEM.E.
(O) CRESPIN, George Theodore Florimond
(P) DE LA MARE, Prof. Peter Bernard David, M.SC.(N.Z.), D.SC., PH.D.(LOND.)
DOWNING, Eric, B.SC., PH.D.(LOND.)
(EE) EMBLETON, James Robert
(P) FRIEND, Norman Alfred Child, B.SC., PH.D.(LOND.), A.R.C.S., D.I.C.
(F) GILLILAND, Raymond Brian, B.A., B.SC.(DUBL.)
(P) HARWOOD, Frederick Allan
(P) HICKMAN, Albert Charles Thomas, B.SC.(LOND.)
(P) HOOPER, Kenneth Charles, B.SC., PH.D.(LOND.), A.R.C.S., D.I.C.
(B) HOUSTON, John, D.SC.(BELF.)
(P) JACK, David, B.SC.(GLAS.), PH.D.(LOND.), F.P.S.
(OJ) JEGATHEESAN, Krishnasamy Aiyer, B.SC.(CEYL.), PH.D.(LOND.)
(Q) LANGLEY, Edward William, B.SC.(LOND.)
(M) MALIN, Leonard, B.SC.(LOND.)
(P) MAYNARD, Thomas Reginald, B.SC.(LOND.)
(P) OGILVIE, Alexander, B.SC.(GLAS.), A.R.C.S.T.
(P) PINCHIN, Frank James, B.SC.(LOND.)
(F) SILBERMANN, Werner Ernst, B.SC., PH.D.(LOND.)
(OJ) SIRIWARDENE, Parana Palliya Guruge Lionel, B.SC.(CEYL.), PH.D.(CANTAB.)
(D) THOMSON, Alexander Ferguson, B.SC.(GLAS.).
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(Q) WOODS, John, B.SC.(LOND.)

GRADUATE MEMBERS ELECTED TO THE ASSOCIATESHIP

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(Q) BARNES, Peter, A.R.T.C.S.
(P) CLEMENTS, Herbert George
(C) DAVIES, Clive, B.SC.(WALES), M.INST.F.
(O) DRAPER, Francis
(Q) DUCKWORTH, Fred
(Q) EASTWOOD, Alan Roy
(O) FENERTY, Joseph, B.SC.(DUNELM.)
(WW) FORRESTER, Alexander Robert, A.H.-W.C.
(P) FORTH, Marjorie Iris, A.R.T.C.S.
(Q) GOSLING, John Graham, A.R.C.S.T.
(C) HEWITT, Peter Walter James
(O) HOOKE, George Frederick, A.C.T.(LIV.)
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(O) WILKINSON, George Stanley

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(OK) WHITE, Clifford Alan, B.SC.(SHEFF.)
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(SS) GRAYSTON, Gerald Robert
(P) GREBBELL, John
(P) GRIGG, Ronald Ernest
(N) HADDOCK, Ernest
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(P) HEINEMANN, Brigitte

(N) HEMINGWAY, Eric
(P) HUNT, David William
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(P) MAXWELL, John Malcolm
(P) MENDHAM, John
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(P) NYE, Martin John, B.SC.(LOND.)
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(P) PARSONS, Derek George
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(C) PITT, Ernest Edgar Halford, B.SC.(BRIST.)
(Q) PITT, Michael Charles
(C) POWER, David Moorfield, B.SC.(BIRM.)
(P) RATCLIFFE, Neil Thomas
(C) ROBB, Donald Athol, B.SC.(BIRM.)
(P) ROBERTS, John Lawrence
(K) ROWAN, Thomas, A.R.C.S.T.
(O) ROWLAND, Ronald
(C) RUDD, Eric James
(P) SANDON, Peter Thomas Sydney
(O) SEERY, Kevin James Mary
(P) SINCLAIR, Alexander
(P) SKRIMSHIRE, Anthony John Hamor
(P) SMITH, Edward Richard, DIP.TECH.
(P) SMITH, John Royston
(P) SOBELL, Maurice, B.SC., PH.D.(LOND.)
(X) SPEAKMAN, Kenneth
(P) SPILLANE, Geoffrey William
(C) STAGG, Roderick Bernard Louis, B.SC.(BIRM.)
(P) STILL, Richard Heywood, DIP.TECH.
(O) TAYLOR, Frederick Brian, B.SC.(LIV.)
(P) THOMPSON, Michael, B.SC.(LOND.)
(P) THORNTON, Charles Barrie, B.SC.(LOND.)
(Q) UMFREVILLE, John Herbert
(P) UPPERTON, Albert Michael
(O) WARD, John William, B.SC.(MANC.)
(SS) WATSON, Brian William, B.SC.(S'TON)
(G) WESTMAN, Kevin, DIP.TECH.
(G) WHITESIDE, Ian Robert
(EE) WILLIAMSON, Ian Perry, B.SC.(BIRM.)

DEATHS

Fellows

(M) BACKSHELL, Arthur Price. Died 18 October, 1960, aged 58. *A.* 1933, *F.* 1943.

(U) BOOTH, Norman Joseph, M.SC.TECH.(MANC.). Died 22 September, 1960, aged 58. *A.* 1931, *F.* 1941.

(P) JENKS, Robert Leonard. Died 23 October, 1960, aged 89. *A.* 1899, *F.* 1902.

(P) JONES, George Cecil. Died 30 October, 1960, aged 87. *F.* 1902.

(Q) POLLITT, Alan Ashton, M.SC.TECH.(MANC.). Died 23 October, 1960, aged 65. *F.* 1943.

(P) SMITH, Sir Ernest Woodhouse, C.B.E., D.SC.(MANC.). Died 7 November, 1960, aged 76. *F.* 1917.

(P) SPETTIGUE, Ralph Hayden, B.SC.(LOND.). Died 15 November, 1960, aged 60. *A.* 1922, *F.* 1957.

(W) TICKLE, Thomas, B.SC.(LOND.). Died 29 October, 1960, aged 89. *A.* 1900, *F.* 1903.

(R) WADE, Frank, T.D., B.SC.(LOND.). Died 18 October, 1960, aged 82. *A.* 1901, *F.* 1904.

Associates

(P) BRESSEY, Ralph John, M.A., B.SC.(OXON.). Died 27 October, 1960, aged 55. *A.* 1928.

(WW) DEWAR, George. Died 14 January, 1957, aged 78. *A.* 1918.

(A) MACLENNAN, George, B.SC., PH.D.(EDIN.). Died 25 October, 1960, aged 28. *A.* 1956.

Graduate Member

WALDRON, James. Died 2 August, 1960, aged 23.

LOCAL SECTIONS DIARY

Sections are glad to welcome members of other Sections to their meetings and social functions, except when numbers are restricted, as for works visits. Those wishing to attend meetings outside their own area are advised to write to the Hon. Secretary of the Section concerned, as the Institute cannot accept responsibility for any alterations or cancellations. All times are p.m. except where otherwise stated. For key to Local Sections *see J.*, 416.

(A) **Aberdeen.** 19 Jan. 8. The Production of Phosphoric Acid and Ammonium Phosphate-Based Fertilizers. Dr J. S. S. Reay. Chemistry Department, The University. Joint, C.S. and S.C.I.

(B) **Belfast.** 2 Jan. Afternoon Lecture and Demonstration for Schools: Some Uses of Ion Exchange. Dr T. V. Arden. Lecture Theatre, Queen's University, Stranmillis Road

(C) **Birmingham.** 18 Jan. 6.30. The Actinomycin Antibiotics. Prof. A. W. Johnson. College of Advanced Technology

(R) **Bournemouth.** 6 Jan. 7.30. Poisoning: Accident, Suicide or Murder? Dr F. E. Camps. Grand Hotel. Joint, Pharmaceutical Soc.

(D) **Bristol.** 12 Jan. 6.30. The Analysis of Plastics. Dr J. Haslam. Chemical Department, The University

(P) **Cambridge.** 12 Jan. 7.30. Social Meeting and Film Show. Technological Research Station, Spillers Ltd., Station Road
—— 24 Jan. 7.45. The Toxicology of Fluorine Compounds. Dr B. C. Saunders. Technological Research Station, Spillers Ltd, Station Road

(T) **Connah's Quay.** 25 Jan. 7. Wines: lecture by a representative of John Harvey & Sons Ltd

(FF) **Dundee.** 20 Jan. 7.15. Educational Symposium. Technical College, Bell Street

(J) **Edinburgh.** 12 Jan. 7.30. Chemistry and Brewing—a New Outlook. Dr A. H. Cook. Heriot-Watt College, Chambers Street. Joint, C.S. and S.C.I.
—— 20 Jan. Annual Dinner. Roxburghe Hotel, Charlotte Square. Joint, C.S. and S.C.I.
—— 31 Jan. 7.30. Some Hydrocarbon Complexes of Transition Metals. Prof. P. L. Pauson. Biochemistry Lecture Theatre, Teviot Place. Joint, C.S., S.C.I. and University Chem. Soc.

(P) **Enfield.** 23 Jan. 7. Chemical Control of Plant Diseases. Prof. R. L. Wain. Technical College, Queensway, Ponder's End

(P) **Gravesend.** 10 Jan. 7.30. Science and Archaeological Investigation. H. M. W. Hodges. Technical College, Mayfield Hall Annexe, Pelham Road. Joint, Gravesend and District Engineering Soc.

(L) **Huddersfield.** 12 Jan. 7.30. Ladies' Night: Wine. G. Osgood. Followed by a 'Wine Tasting.' Alexandra Chambers, 32 John William Street

(N) **Leeds.** 23 Jan. 6.30. New Polymers. Dr R. Smith. Chemistry Lecture Theatre, The University

(P) **London.** 18 Jan. 6.30. Aspects of the Chemistry of Living Cells. Prof. Sir C. N. Hinshelwood. King's College, Strand, W.C.2

(Q) **Manchester.** 12 Jan. 7. A.G.M., followed by Address: The Proposed New Grade of Membership of the R.I.C. Dr G. R. Ramage. Manchester Literary and Philosophical Society Lecture Theatre, 36 George Street

(S) **Newcastle.** 25 Jan. 6.30. The Co-ordination Chemistry of some Organo-metallic Compounds. Prof. G. E. Coates. Rutherford College of Technology. Joint, S.C.I.

(E) **Newport.** 20 Jan. 7. Problems in the Production of Radio-isotopes. Dr J. C. Charlton. College of Technology, Allt-yr-yn. Joint, S.C.I.

(X) **Norton.** 19 Jan. 8. Scientific Journalism. Dr P. Ritchie Calder. William Newton School

(G) **Norwich.** 20 Jan. 7.30. Chemistry in the Preservation of Antiquities. Dr A. E. Werner. City College. Joint, Norfolk Research Committee

(H) **Nottingham.** 19 Jan. 7.30. Forensic Science. D. N. Jones. Nottingham and District Technical College

(W) **Plymouth.** 20 Jan. 5.30. Electrochemical Analysis. E. Bishop. Technical College

(R) **Portsmouth.** 16 Jan. 7. The Work of the Railway Chemist. E. Henley. College of Technology. Joint, Portsmouth and District Chem. Soc.

(SS) **Preston.** 19 Jan. 7.30. Aromatic Character and the Inorganic Aromatics. Prof. D. P. Craig. Harris College
—— 27 Jan. 2.30. Young People's Lecture: Chromatography. R. A. Wells

(EE) **Seascale.** 27 Jan. 8. Some Aspects of the Solvent Extraction of Metal Halides. Dr A. G. Maddock. Windscale Club

(P) **Slough.** 25 Jan. 7.30. Magnetism in Inorganic Chemistry. Prof. R. S. Nyholm. College of Further Education, William Street. Joint College Scientific Soc.

(WW) **Stirling.** 25 Jan. 7.30. Short Papers by Local Members. Golden Lion Hotel

(C) **Stoke-on-Trent.** 26 Jan. 7.30. Unusual Properties of Nitrates. Prof. C. C. Addison. College of Technology

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